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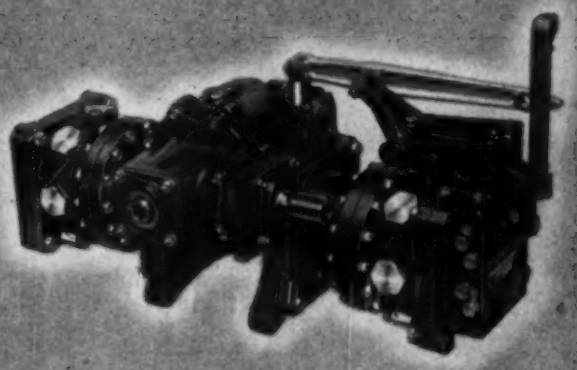

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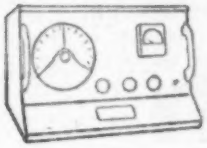

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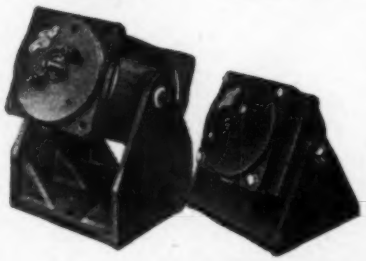

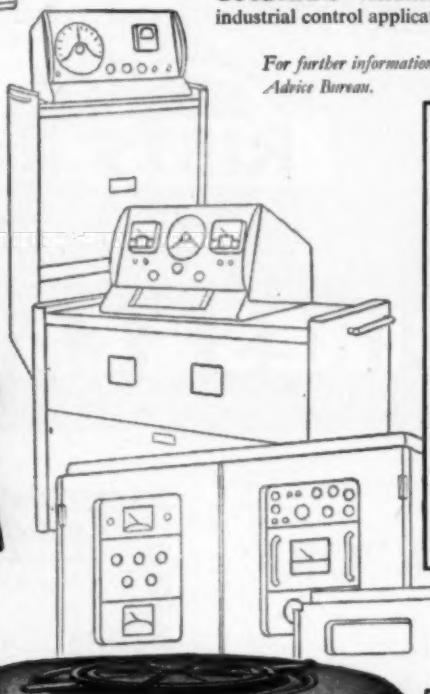

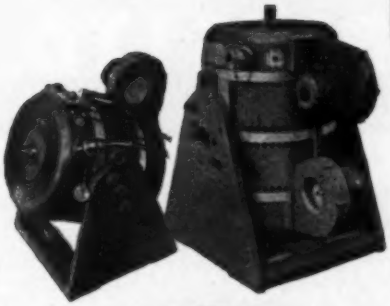

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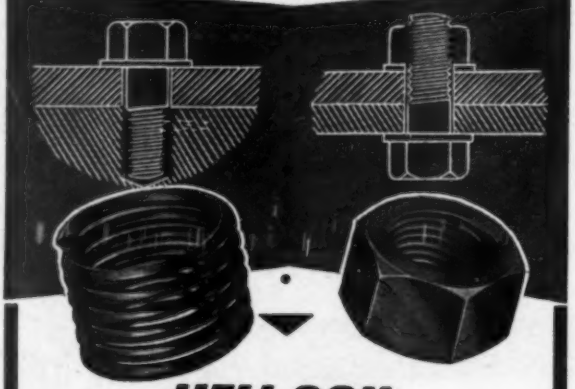

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Hylite 30 TITANIUM ALLOY. 2% Manganese, 2% Aluminium Alloy. A relatively low alloy bridging the gap between commercially pure and the higher strength alloys.	2% Mn., 2% Al.	36.0	44.0	20.0	240
Hylite 40 TITANIUM ALLOY. 4% Manganese, 4% Aluminium Alloy. A higher strength alloy suitable for compressor discs and blades.	4% Mn., 4% Al.	58.0	62.0	18.0	300
Hylite 45 TITANIUM ALLOY. 6% Aluminium, 4% Vanadium. A high strength alloy which responds to heat treatment. Available in sheet form as well as rolled bar and forgings.	6% Al., 4% V.	58.0	63.0	22.0	300
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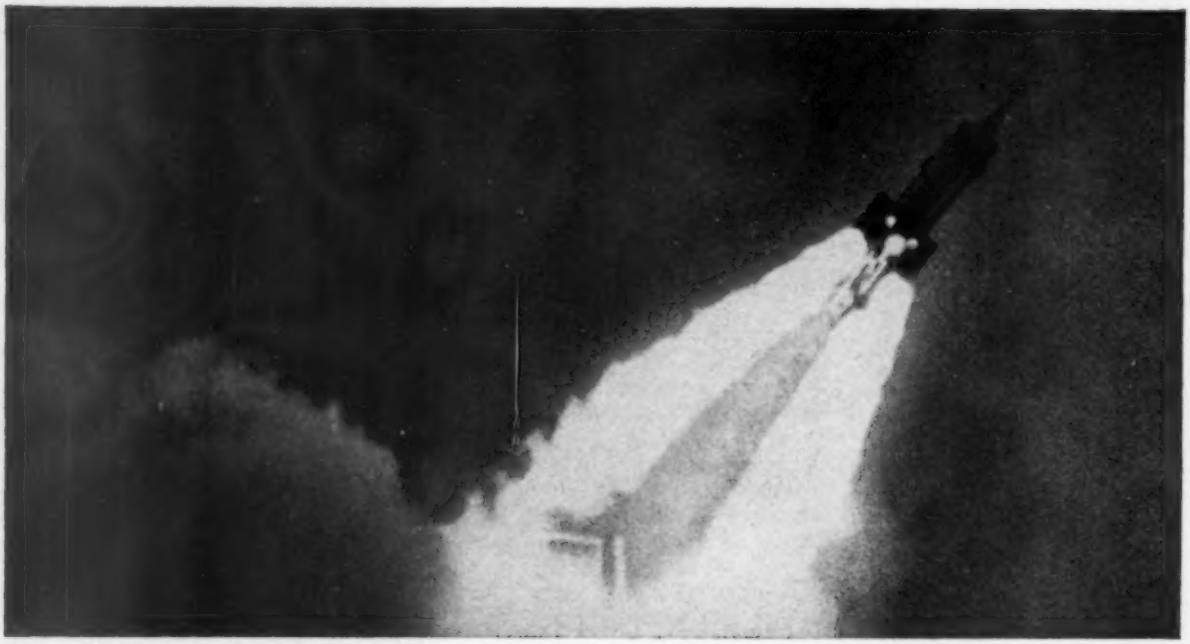


A Seaslug test vehicle being fired. In missiles of this type the Armstrong Whitworth IPN Gas Generator has been tested and proved under actual flight conditions.

IPN* revolutionises missile power supplies

Details of the new Armstrong Whitworth Gas Generator

Many liquid fuels have been tried as possible solutions to the auxiliary power problems of missiles, but not till Armstrong Whitworth developed the use of Isopropyl Nitrate was there any which could be pronounced an unqualified success. The result of Armstrong Whitworth work, the Type TP-1 Gas Generator, has been tested under flight conditions, where it proved entirely satisfactory. The advantages of the TP-1 Gas Generator are:—

No fuel waste. The IPN generator can vary the amount of fuel burnt so that it supplies only the exact amount of gas required by the machinery at any given time. This gives it a distinct advantage over solid fuel systems, which all the time supply enough to meet the maximum demand (probably made only 5% of the time).

Light weight. Because of its fuel economy, the IPN generator carries no excess weight.

Compactness. IPN is stored in tanks built into the generators — unlike high-pressure gas which needs bulky bottles.

Unaffected by atmosphere. Ram-air systems are limited to the lower atmosphere, solid fuel varies its burning rate according to the surrounding temperature. With IPN there are no such problems.

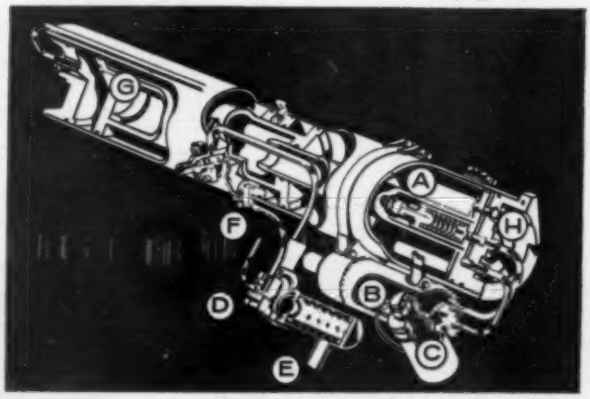
Ease of storage. The IPN generator can be stored fully loaded for two years and needs no maintenance or topping up.

Safety. IPN cannot be detonated by shock, and needs no other precautions than those normally taken with inflammable fluids.

Isopropyl-Nitrate *

THE ARMSTRONG WHITWORTH IPN GAS GENERATOR

Type illustrated measures 29.8" x 5.5" x 10.3"



IPN from fuel store (A) enters combustion chamber (B) is ignited by cordite charge (C).

At (D) hot gas joins atomised coolant. Most of resultant mixture goes to operate power supplies machinery, via supply line (E). Some, however, is tapped off through pipes (F) to drive pistons (G) which expel fuel and coolant, so making the system self-sustaining.

Gas tapped off from combustion chamber operates fuel control valve (H), which limits supply of fuel to exact amount required by machinery.

Armstrong Whitworth can tailormake IPN units to customers' own specifications, and will always be glad to advise on technical problems.

British and Foreign patents applied for

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and
AIRCRAFT ENGINEER

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Collision

NOTHING cuts more deeply into the hearts of airmen, and the consciences of safety authorities, than the word collision. When two aircraft collide in mid-air the result, except by mere chance, is disaster. The possibility of collisions between military machines is accepted as one of the normal risks of Service flying: collisions involving commercial aircraft must never happen. But in America, within the space of one month, two airliners have been struck out of the sky by military jets at a terrible cost in civilian lives and with an unquestionably serious effect upon the minds of would-be air passengers. Confirmed reports of near-misses are so numerous (971 in the U.S.A. last year) as to send a shudder through the whole system of the air transport business. The concern of the public is equalled by the anger of the airlines, which is now at white heat. Already huge sums have been allocated to the improvement of America's traffic control system—more radar, more A.T.C. automation, better ground aids. A special Airways Modernization Board is answerable directly to President Eisenhower. Three new 40-mile-wide transcontinental airways have been created.

Can more be done? The only solution, which applies just as much in Europe as it does in America, is *joint control* of all civil and military traffic. As long ago as October 1956 the U.K. Guild of Air Traffic Control Officers made this declaration: "There must be joint centres of military and civil control, to destroy once and for all the gulf at present between them, which is strewn with prejudice and mistrust engendered by ignorance of each other's task."

It requires but a moment's thought to appreciate the massive problems which daunt the achievement of 100 per cent joint civil and military control. But it must come to pass; and all hopes for the future (notwithstanding the present events in France) rest on the fact that, in the Western European and North American democratic systems, it is *civil* law which must prevail. British air space is a national trust, for the defence of which R.A.F. Fighter Command is maintained by national funds. Subject to the imperative needs of that Command, and those of other home-based Commands, to practise and improve in their prescribed rôles, the Service must use that air space on the civilians' terms.

A New Security?

SINCE 1945 the industrial and political undercurrents of aviation have, in most countries, settled into fairly well-defined channels. In the U.S.A. it is now accepted practice for a newspaperman—or anybody else—to publish anything that, in his estimation, is of news value; and the onus is placed on the source of information to withhold it if there are reasons why it should not become public property. The deliberate "leak," by a manufacturer or a Service chief with an axe to grind, is an everyday occurrence.

In this country, where reticence and unwillingness to be ungentlemanly are supposed to be powerful factors, we have placed the onus on every single citizen to observe the laws of security; and, although secret information on aircraft and missiles is by no means difficult to obtain, nothing of calamitous consequence has been published in the past decade. Now, it seems, the pressures brought about by contractions, regroupings, retrenchments and every other type of upheaval may be tempting us over to the "Stateside" security school. In recent days there have arrived in these offices—as in most domiciles of these islands—lengthy newspaper reports of a variable-geometry flying machine which has been under development by Vickers-Armstrongs (Aircraft); another referring to progress made with Blue Streak, our 2,200-mile ballistic missile; a quote from Hansard discussing something called Operational Requirement 339; and a newspaper story which describes a proposal by Hawker Aircraft for an Orpheus-powered VTOL fighter. These items were not, of course, deliberate "leaks." Nevertheless, the nation must be vigilant lest, as competition is brought to a keener edge, the protective powers of "security" diminish to the degree of futility.

FROM ALL QUARTERS

Overseas Earnings

EXPORTS by the aircraft industry for the first four months of this year reached a record total of £50,257,246, representing a gain of 53½ per cent over the figure for the same period of 1957. This January-April total—handsomely exceeding the annual totals for every year up to and including 1952 and only falling short of the 1953-55 totals by a maximum of £16m—represents £150m for the full year (compared with last year's record £116½m). The industry is earning, says the S.B.A.C., "on average, about £3m in overseas markets every seven days."

The April total, £13,923,247, was the third highest monthly figure ever achieved. Aircraft and parts accounted for £9,671,599; aero-engines £3,744,586; electrical equipment £293,928; tyres £59,893; and aeronautical instruments £153,241. Canada was the industry's best customer, spending £2,282,905; next in order were India (£1,819,478), Eire (£815,634) and West Germany (£637,737).

Dollar exports during the January-April period were at £7.4m greater than ever before.

New R.Ae.C. Chairman

CHAIRMAN of the Royal Aero Club for 1958-59 in succession to Mr. S. Kenneth Davies, C.B.E., is Col. C. F. H. Gough, M.C., T.D., Member of Parliament for Horsham, Sussex, since 1951 and a company director. Col. Gough joined the Royal Aero Club in 1936 and has been a committee member since 1953. One of the eight original commanding officers within the 1st Airborne Division, he is a qualified parachutist and commanded the 1st Airborne Reconnaissance Unit from 1941 until captured at Arnhem in 1944. A co-founder of the Airborne Club and a director of the British Sailors Society, Col. Gough formed and commanded the 11th Battalion of the Parachute Regiment, Territorial Army, in 1947-48. Details of other Royal Aero Club committee appointments for the coming year are given on page 768.

The Cockerell Hovercraft

BECAUSE any disclosure before the patent is registered might mean the loss of the idea to British industry, details of the "hovercraft"—which operates on the principle of frictionless movement—are being kept secret and its inventor, Mr. Christopher Cockerell, has been instructed by the Ministry of Supply not to discuss it. Mr. Cockerell, who trained as an electronic engineer at Cambridge and runs a fleet of boats for hire on the Broads, said recently that he had applied his engineering and electronic knowledge to the technique of boats and the "hovercraft" was the result of an idea he had been investigating since 1953. "We know that the Americans are working on the same principle," he said, "trying to evolve a method of providing a 'cushion' of air beneath an object which will allow it to be moved without the friction of wheels or water." Saunders-Roe, Ltd., are studying the scheme.

A. V. Roe Flight Claim

ON the 50th anniversary of his father's first flights, in June 1908, Mr. Geoffrey Verdon-Roe has claimed that Sir Alliott was in fact the first British pilot to fly a heavier-than-air machine in the British Isles; and he is asking the Royal Aero Club to reconsider its decision—based on the Gorell Committee finding in 1928—that the first flight was made by Lt-Col. J. T. C. Moore-Brabazon (now Lord Brabazon) on May 2, 1909.

Mr. Verdon-Roe has assembled a considerable amount of evidence in support of his claim, including several eye-witness and other accounts and an opinion on A. V. Roe's flights in 1908 by Mr. E. J. Richards, professor of aeronautical engineering at the University of Southampton. Prof. Richards writes in a letter to Mr. Verdon-Roe:—

"As far as I can see this claim appears substantiated in spite of the Gorell Committee's decision against it. Indeed, by their own definition of a free flight [*when the machine is maintained in the air by its own power on a level or upward path, for a distance beyond and over which gravity and air resistance would sustain it*] it is possible to prove that your father was in a true flying condition, though it must be admitted, by modern standards, not for long."

Prof. Richards estimates the airborne distance in a trajectory to have been 38ft, adding "thus your father was truly airborne for 62-112ft distance greater than this and was flying level during this distance, an unquestionable free flight under the definition of the Gorell Committee of between five and eight times the trajectory distance."

U.S.A.F. "New Generation" Types

ALREADY the U.S. Air Force is ordering aeroplanes more advanced than any known to be planned elsewhere; in particular, reference may be made to the North American B-70 long-range bomber and F-108 intercepter, both of which are intended for Mach numbers exceeding 3. It is worth noting, therefore, that Lt-Gen. Clarence S. Irvine, deputy chief of staff for Materiel, announced recently that "there definitely will be another family of manned aircraft beyond the B-70 and F-108." He was speaking at the dedication ceremony of the $30m research centre of Pratt and Whitney Aircraft at West Palm Beach. During the ceremony the new high-airflow J58 turbojet was publicly unveiled.

English Electric Directorship

IT is announced that Sir Archibald Finlayson Forbes, G.B.E., has been elected a director of the English Electric Co., Ltd. In 1940 he was appointed Director of Capital Finance at the Air Ministry and subsequently Deputy Secretary of the Ministry of Aircraft Production. In 1943 he was made Controller of Repair, Equipment and Overseas Supplies, and a member of the Aircraft Supply Council, holding both positions until 1945. In the following year he became chairman of the first Iron and Steel Board, and he was president (1951-1953) of the Federation of British Industries.

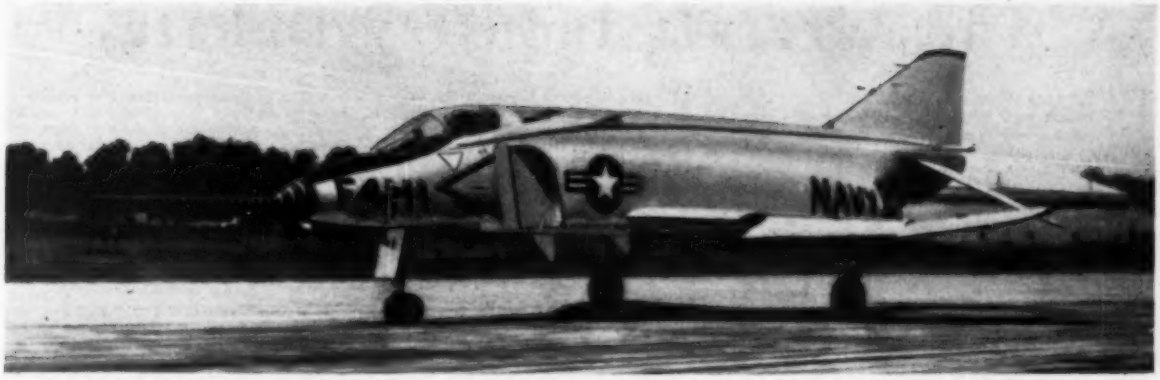
Sir Archibald Forbes.

R.Ae.C. International Rally

AT Shoreham Airport last week-end the Royal Aero Club welcomed visitors by air from home and overseas to their international rally. Although a few entrants were prevented by weather and other causes from arriving, 14 aircraft from abroad—Belgium, Holland, France, Denmark, Ireland and Italy—had assembled, and a slightly greater number from various home bases were there to swell the total. The week-end followed the pattern made traditional by the many Continental rallies which British pilots and crews have attended in the past; there were visits to London and local coast resorts, the Mayor of Brighton gave a civic reception, and a banquet and ball were held on Saturday at the Grand Hotel, Brighton.

Among the more interesting of the visiting aircraft—some of which Royal Aero Club members had a chance to sample—were the fighter-like Falco F.8 from Italy, a Jodel D.117 from France and a pair of Czechoslovak Sokols from Holland. Much favourable comment was also accorded to Maj. J. M. Pratt's Bücker 181—a German aeroplane registered in France and American-owned. Also in evidence were the Miles HDM.105 (demonstrating very effective steep turns on one dead engine), a pair of Jackaroos which arrived in formation, and the very trim blue-and-yellow French Emeraude F-BIMG. It is understood that French-built aircraft of this type may be offered for sale in this country at a price of about £1,900.

SITTING ON AIR: The Short SC.1 VTOL research aircraft (five Rolls-Royce RB.108) is seen hovering, on May 26, above the platform of its gantry at Sydenham, Belfast. Several flights of this kind were made on that day by Tom Brooke-Smith, who will be responsible for the whole flying programme of this unique aircraft.



MISSOURI MONSTER: The McDonnell F4H-1 two-seat all-weather fighter of the U.S. Navy reveals its curious droop-snoot wings and anhedral tailplane. Powered by two G.E.J79s with afterburners the F4H has blown flaps and can carry a Hound Dog missile or, as seen here, four Sparrow 3s. The Navy have bought 23 development F4Hs at $7,405,000 each; full production depends upon an evaluation against the Chance Vought F8U-3.

Prince Cantacuzene

WE record with regret that Prince Constantin Cantacuzene, known to us on *Flight*, as to numerous other friends in Great Britain, as "Buzz," died in Madrid last week at the age of 49, following a short illness. "A romantic figure with a highly practical turn of mind and an aerobatic pilot of the first rank" —as we described him a few years ago—he was a Rumanian by birth. He gave brilliant performances at air displays all over Europe, his usual mount being a Bücker Jungmeister (recently fitted with a Lycoming 275 h.p. engine), in which he executed astonishing and varied evolutions. His *tour de force* occurred at the very end of a typical demonstration — when everybody thought it was over and the Bücker's wheels were about to touch down. Cantacuzene would then give his engine a burst of throttle and, having gained a few feet of height, whip the aircraft over in a flick roll—performed at so low an altitude that it could almost have been done under a hangar roof.

"Buzz" in a Spanish AISA I-11.

Typical of the affection in which the Prince was held was the fact that, when he fell ill, efforts to save his life were marked by offers of blood transfusions from scores of members of the Spanish Air Force.

Chester Garden Party

AN aeronautical garden party organized by Chester branch of the Royal Aeronautical Society was held at Broughton Airfield, Denbighshire, last Saturday; and Sir Arnold Hall, who as the Society's president performed the opening ceremony, rightly congratulated the Chester members on their initiative, saying that as far as he was aware it was the first time one of the R.Ae.S. branches had ever held such a function. He added that he was not exactly sure how one "opened" a garden party; he thought he might have had to make a parachute jump, but he had been let off that.

It transpired during the next two-and-a-quarter hours that parachute jumping was about the only thing missing from an entertaining agenda. This ranged from a fleeting but impressive P.1 visitation (on test from Warton and flown by Desmond de Villiers) to some fast passes by R. W. Ford in the Fairey Junior, its 62 h.p. Walter Mikron going all out; from a somewhat nostalgic asymmetric demonstration of a Mosquito T.3 by F/L. Page to swoops by Sedberghs of No. 631 A.T.C. Gliding School; from a Beverley which looked in weightily from Shawbury to prettily co-ordinated antics by an Auster Alpha and Autocrat and a civil Percival Prentice.

Perhaps the most outstanding items in a programme which also included a Wicko, a Tri-Pacer (flown over from Ireland by its owner, the Marquis of Kildare), a Bonanza, a Leopard Moth and a Swordfish were first-class shows by F/L. Hamilton in a Whirlwind and F/L. Edwards in a Vampire T.11. The latter's cleanly executed aerobatics, including an inverted pass and ending with a delicate stall turn, formed a delightful finale to the flying part of an ambitious and deservedly successful garden party.

IN BRIEF

The first attempt to launch into orbit a full-size (20in diameter) Vanguard satellite was made at Cape Canaveral on Tuesday, May 27, and was unsuccessful. The satellite attained a height of about 2,000 miles. The small test sphere launched into orbit on March 17 was the only successful attempt out of the four Vanguard firings which preceded that of the 20in sphere.

* * *

Lt-Cdr. J. F. S. Overbury, senior test pilot of Saunders-Roe, Ltd., who was injured in an accident when he was demonstrating a Druine Turbulent at Sandown, I.o.W., on Whit Monday and was taken to hospital, is reported to be progressing favourably.

* * *

The 12-volume Rothschild collection of pioneer air stamps and covers—formed by the late N. C. Rothschild—is to be sold next Monday (June 9) by H. R. Harmer, Ltd., 41 New Bond Street, London, W.1. It includes a pair of Newfoundland 3 cent stamps overprinted for the Hawker-Grieve Atlantic attempt.

* * *

D. Napier and Son, Ltd., are holding an exhibition at the Tea Centre, Lower Regent Street, London, W.1, to mark the 150th anniversary of their founding. Illustrating the many different products designed and manufactured by the company during its long history, the exhibition is open to the public until June 14 (10.30 to 6 p.m. weekdays, 10.30 to 1 p.m. Saturdays). Admission is free.

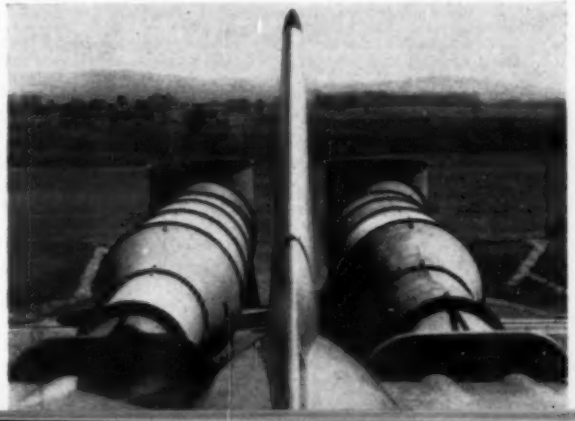
* * *

At the Royal Air Forces Association annual conference, held last week-end in Edinburgh, Air Marshal Sir Harold Lydford was elected chairman of the national council in succession to Air Marshal Sir Robert Saundby. Among resolutions carried at the conference was one asking that the Air Ministry should be impressed with its "increasing responsibility for giving priority to former R.A.F. and W.R.A.F. personnel when filling vacancies at the Air Ministry and R.A.F. establishments."

* * *

Full reports of the Senior, Sidecar and Lightweight T.T. Races in the Isle of Man appear in the next (June 12) special issue of our associated journal *The Motor Cycle*.

QUIETING VULCAN'S FORGE: The new, twin, 54ft-long muffler units now in use at Avro's Woodford (Cheshire) airfield with the Bristol Olympus turbojets of the Vulcan V-bombers. A Vulcan is towed into position and the mufflers (fabricated within the Hawker Siddeley Group) are then wheeled sideways on rails set in a concrete base.



The Aircraft Industry Debate

LAST week *Flight* summarized the aircraft industry debate which took place in the House of Commons on May 22. Lasting 6½ hours, it was the most comprehensive Parliamentary discussion of the aircraft industry for two-and-a-half years. Points from speeches are given more fully hereunder; and for quick reference selected items, not in chronological sequence, are grouped together under specific headings.

Research. MR. GEORGE BROWN (Lab., Belper): "Not only was the [Minister's statement on research and development] excessively vague . . . but the Minister succeeded in substantially concealing from the House that he was virtually offering the industry nothing at all. The Minister's statement goes less far than any of us at the time thought . . . he managed to make it in a way which has aroused a great deal of criticism and irritation in the industry . . ."

"The statement is a firm statement. It says that the responsibility for the cost of this research will be passed over to the industry in the future . . . Does the statement mean what it says, or does it not?"

MR. AUBREY JONES (Minister of Supply): "I am sorry that the right hon. Gentleman takes a poor view of it, but I think it was the decision which essentially the industry wanted. I will leave it at that."

MR. WILLIAM SHEPHERD (Con., Cheadle): "One must realize that in a large concern research and development staff constitutes 20 per cent of the total staff employed. It amounts to at least 33½ per cent of the weekly wage bill. If a firm, with the best intentions—but in my view unsoundly—tries to amalgamate and keep two research and development staffs going, it will be on the road to disaster . . ."

MAJ. E. A. H. LEGG-BOURKE (Con., Isle of Ely): "Who is his [the Minister of Supply's] master? It is the Treasury. Every time it is the Treasury. It is the Treasury that caused the cut in defence expenditure some time ago. It is the Treasury that brought about the position where we could not afford short-term and long-term activities. It was the Treasury that said it was not prepared to cut the social budget by more than a certain amount and that, therefore, the money must come from the defence budget. It is the Treasury that has said that it is more important to put more money to old-age pensions than to put it into research."

MR. FRANK BESWICK (Lab., Uxbridge): "What does the Minister mean by his statement [that the industry will progressively assume financial liability for research] . . ? Does he mean that, in the course of time, he will present them with a bill for the cost of the research? Is it to be on a repayment basis . . . What exactly does that statement mean?"

"There is no impression of a long-term policy. The feeling I have is one of an *ad hoc* or piecemeal approach to the whole business. There is one thing that is absolutely certain . . . It is that we cannot have profitable and sustained research on a cap-in-hand basis. If [firms] have to go to the Treasury on each project and have to try to explain to people who may be very clever on financial matters but absolutely ignorant about aircraft, then we shall not only frustrate the individual research officers concerned but will not give the nation the results we want."

"There is another reason why I think we cannot carry out basic research of this kind on a temporary and piecemeal basis. We must have a long-term budget for research. There must be a certain amount of basic research going on the whole time, quite irrespective of the month-to-month or even year-by-year scrutiny of the Treasury."

Current British Civil Aircraft. SIR ARTHUR VERE HARVEY (Con., Macclesfield): "Had this [the Wright Turbo-Compound engine which, according to *Aviation Week* 'is the target of mounting criticism from airlines and engineering officials'] been a British engine such as the Britannia's, which has given a certain amount of trouble, we should never have heard the end of it. Every newspaper would have reported every single engine failure."

"America is able to offer enormously long-term credits compared with ours, because their Government make it possible to do so. Have Her Majesty's Government thought about this? Has the Minister any ideas about it? Does he realize that something must be done . . . ?"

"Is my right hon. Friend aware that this matter [credit competition] has been known now for at least a year? While the Government are examining the matter, good business is being lost. Will he give the House some assurance that the matter will be dealt with expeditiously in order to put the British industry on an equal footing with its competitors?"

MR. AUBREY JONES: "I am prepared to concede immediately that this is the most important question facing the industry. I think there are probably two sides to it. There is, first of all, the length of time for which the Export Credit Guarantees Department extends its insurance. In this country, the maximum period for the insurance is five years, but I understand that the American companies receive from the Export-Import Bank insurance extending over seven years. This is a subject currently being examined, and I am not in a position to announce any conclusion. It is being examined as sympathetically as possible, subject to two inevitable limitations. Clearly, the Export Credits Guarantees Department is required by statute to pay its way, and must be inhibited to some extent by certain international agreements. However, the subject is being looked at."

"The difficulty is not so much the terms offered by the Export Credits Guarantees Department, but the greater financial strength of American companies *vis-à-vis* the British companies. This is something we have to look at, and again we have to recognize that the Government can make but a limited contribution to strengthening an individual company . . . That is something which the company must perform itself."

MR. WILLIAM SHEPHERD: "I heard the other day about what was happening to the Lockheed Electra. I understand that the makers of this aircraft go round to operators and say 'If you take this aircraft, you can have it for two years on hire. At the end of the two years, you can decide whether you want to buy it. If at the end of two years you want to buy it, you can set off the amount that you have paid for the two years' hire as a deposit against the aircraft and pay the balance over seven years.' If one were to try to sell, as Vickers are doing, an aircraft competitive with the Electra on ordinary straight five-year terms one would find those methods of selling, to say the least, rather discouraging. In view of the fact that almost every aircraft operating company in the world is almost stony broke and cannot find the money for the aircraft that it has already acquired, these effective and attractive terms are a tremendous discouragement to our people . . . I hope that my right hon. Friend will weigh in to the Chancellor and ensure that our manufacturers are permitted to offer terms at least as satisfactory as those offered by our American competitors."

MR. FRANK BESWICK: "On the one hand, we have offended our New Zealand friends about this business of butter. On the other hand, the T.E.A.L. orders which de Havilland thought they had secured for the Comet 4 seem likely to be lost because of action by the Australian Government. I hope the Minister of Supply will put it to the Prime Minister, no lower, that something extra ought to be done before it is too late to have Commonwealth talks on this matter. And Commonwealth trade is not a one-way affair: there must be a two-way traffic in which we buy their products if they are to take our manufactured goods."

Government Control of the Industry. SIR ARTHUR VERE HARVEY: "I therefore raise the question whether the right thing is not to have a Ministry of Aviation, which will be responsible for production, liaison, research and, also, operations."

MR. AUBREY JONES: "Whilst I understand the right hon. Gentleman's craving for some great centre of Government dealing with the whole of aviation, I honestly think that if he came seriously to examine the question, he would find that it would not be practicable. Anyhow, [an] internal inquiry was set up and it is still not completed."

"I am not a *laissez fairist*. I think that the proper answer here is something between full Government authority and complete *laissez faire*. What we need is a combination of impulse from above compelling the assumption of responsibility on the part of the industry itself."

MR. GEORGE BROWN: "In 1955, I suggested that we ought to have an inquiry. It is an old and cynical joke that whenever a politician cannot think up a good answer he suggests a commission . . . Nevertheless, there are times when we must go outside the Government's machine, because the problem is much wider than any one Government Department can consider."

"I suggest that [a] five-man committee ought to be set up very urgently with a powerful, disinterested but well-informed and authoritative figure as the chairman . . . I believe that in Lord Hives, if he is available, we have a man—I will not say that he is the only man—who would make a natural chairman of such a committee. He is a man of vast knowledge and of great drive, a very disinterested, forthright and straightforward man. I think that in him we have the natural chairman for such a body . . ."

MR. FRANK BESWICK: "There is a sound case for giving some Minister—the Minister of Supply or someone else—not only responsibility but power over aviation policy and to have responsibility not only for the manufacturing of aircraft but airline operating as well. That idea goes into the general pool of ideas, and I trust that some thought will be given to it in future."

Contraction of the Aircraft Industry. MR. AUBREY JONES: "First, I think that an industry which is too dependent on public finance will lose even its most genuine friends, and I think that in fact the aircraft industry was in danger of losing its friends. Secondly, I believe that an industry which is too dependent on public finance will always be reluctant to assume the responsibility of strengthening itself. Some strengthening of the aircraft industry must come from the assumption of responsibility by the industry itself."

"It has been common ground . . . that we wish to save the industry. If there is a difference between us it is that (Mr. Beswick) thinks salvation can come entirely from above, whereas I think some action is needed from above but that some response is also necessary from below. The members of this industry themselves must think long and they must think large . . ."

MR. WILLIAM SHEPHERD: "The fact is that the whole of the [world's] aircraft manufacturing industry, when added together, is a piece of nonsense . . . At the moment 895 projects of some size are being put forward . . . Of that 895, it is questionable whether more than a hundred will ever see a reasonable level of production, and the great majority will never see any production at all."

"This is not an industry. It is a wild, futile, nationalistic scramble by various nations, all saying, 'We must outdo the other fellow. We cannot be under him. If he does it, we must do it.' Hundreds of thousands of millions of pounds of public money have been poured down the drain throughout the world in an attempt to produce aircraft which in the main will never be produced."

MR. FRANK BESWICK: "The Minister talked about handing out development projects to firms which were good and which did as he told them and got together. To whom will he hand out these hypothetical development projects in the future—to Hawker Siddeley, to Bristol, or to the company in between? One of the difficulties about this arrangement is that while we need concentration of units we are in danger of getting proliferation of companies. We have more committees and more companies to deal with."

MR. W. J. TAYLOR (Parliamentary Secretary to the Ministry of

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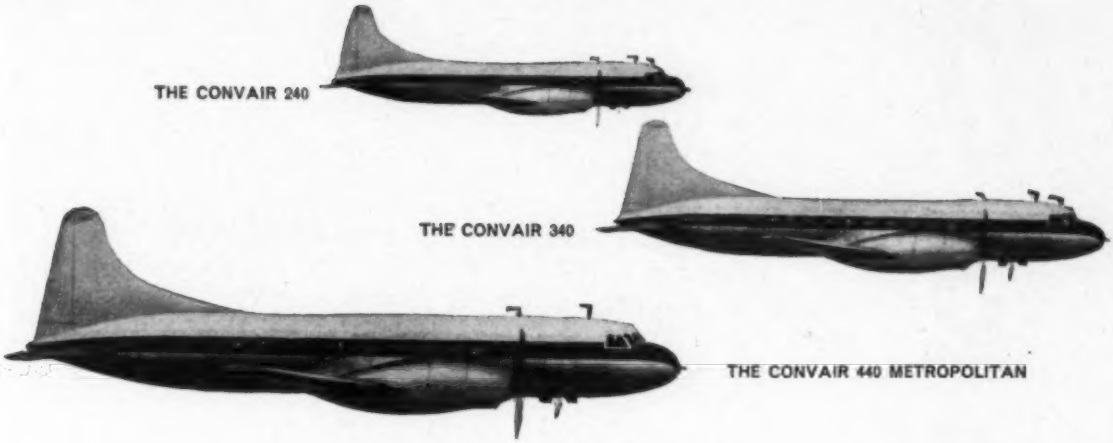

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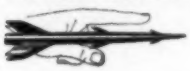

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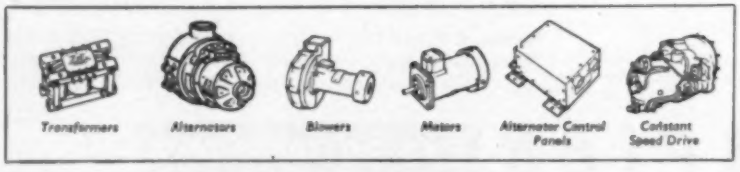


Rotodyne Flight Development

STEADY PROGRESS WITH A UNIQUE FLYING MACHINE

EXACTLY seven months ago the first Fairey Rotodyne took to the air. Since then its flight programme has proceeded in a highly satisfactory manner, more than 80 flights having been logged and a substantial proportion of the difficult task of flight development being satisfactorily completed. It is now possible to present a brief account of what has been done to date.

The manufacture and flight development of a unique machine like the Rotodyne—particularly on such a large scale—presupposes a very great deal of testing in wind tunnels, ground rigs and other aircraft. The use of the Jet Gyrodyne and several of the ground rigs has already been extensively reported in *Flight*. Basic development—largely of an empirical nature—to determine the optimum type of tip jet unit was carried out on rigs at the company's airfield at White Waltham, near Maidenhead, Berks. After static trials, tests were made on a single-blade rotating rig to study the centrifugal effects in the air and fuel flows.

When a good tip unit had been produced a complete rotor was erected at the Aeroplane and Armament Experimental Establishment, together with the two Napier Eland powerplants and their complete control system. Included in this rig are virtually all the untried and critical portions of the Rotodyne, and the rig was found invaluable in ensuring the safety of the aircraft during its early flight trials. At the main factory at Hayes the company constructed a rig for testing the rotor-head swashplate mechanism and hydraulic jacks. Superimposed on this work was the necessity for conducting orthodox fatigue tests on all major aircraft components, the rotor blades being subjected to flight loads while free to oscillate at their natural frequency.

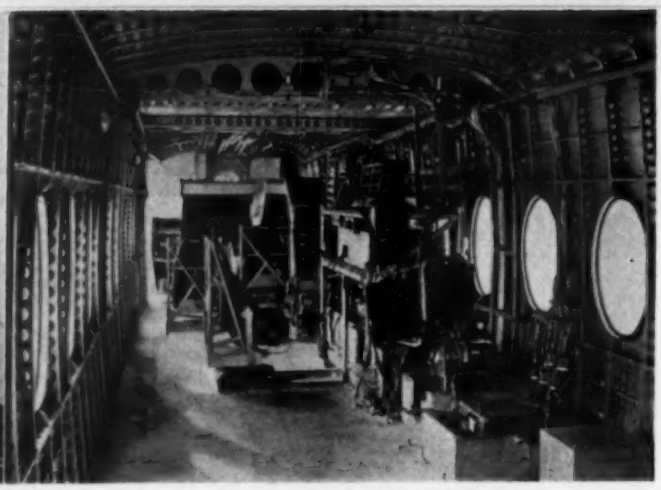
In most helicopters one of the most critical problems concerns ground resonance, and for the Rotodyne a 1/15th-scale model was built with the correct blade inertia and stiffness and with dynamically correct characteristics in the airframe and undercarriage. Extensive tests were made to check the behaviour of the model and to correlate theory with the results obtained. Later, full-scale tests were conducted on the prototype itself. For the latter programme, the rotor blades were replaced by equivalent masses, and an out-of-balance force was fed in at the head, the airframe response at all critical points being measured between 0.5 and 3 c/s. Lift was simulated by slinging the aircraft to a jib and applying lift forces through air jacks (to give a soft suspension at the low frequencies involved) up to the weight of the aircraft. These results were fed back into the model tests, and from the complete picture of ground resonance thus obtainable it could be deduced that, in one rather unusual combination of circumstances, ground resonance might be encountered.

To avoid this trouble, a new retractable undercarriage was designed. Pending delivery of the first set of legs to the revised design, the undercarriage of the prototype was temporarily fixed in the down position with rigid bracing struts. With these struts in place, the final full-scale ground resonance and complete powerplant clearance tests were successfully accomplished in five days.

Ground-resonance testing of the complete aircraft, provided with the temporary fixed undercarriage, began on October 25 last year. This was followed by the final functional checks on the powerplants and control systems, which were completed on November 3. Finally, on November 6 the aircraft started its flight trials, in the hands of S/L. Ronald Gellatly, A.F.C., senior helicopter test pilot, and Lt-Cdr. John Morton.

It must be appreciated that a great deal of the Rotodyne test flying has encompassed fields never before explored outside a tunnel. Initially the aircraft was flown as a simple helicopter, remaining within the confines of White Waltham airfield and rarely being airborne for more than about a quarter of an hour at a time. Each trip was concerned with a particular set of results, and these had to be analyzed before the next step could be taken on the long road to transitional flight, i.e., conversion to autogyro flight. Gradually the flight envelope was extended, according to the predictions resulting from the extensive tunnel testing.

Tunnel testing had indicated that change in trim due to interference between the rotor and airframe would be small and well within available control power. It was also evident that the loss of lift at low speeds resulting from the rotor downwash on the airframe would be quite small. These facts have been borne out in practice, and the powered cyclic and collective-pitch controls have been found to be extremely crisp and precise. Indicative of the latter is the fact that no difficulty has been experienced in restricting the vertical velocity at landing to under 3ft/sec (due to the temporary fixed undercarriage). Again confirming tunnel



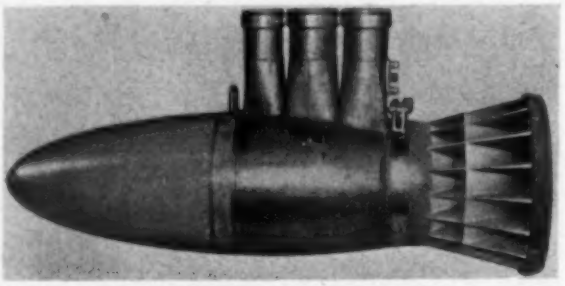
The first prototype undergoing vibration and resonance testing. The aircraft is slung from a jib crane, as described in the text. (Right) A recent interior photograph, showing the considerable amount of instrumentation necessary. Seats for three flight observers can be seen.

ROTODYNE FLIGHT DEVELOPMENT . . .

results, it has been found that change in longitudinal trim as the aircraft gains forward speed from hovering, or moves out of the ground cushion, is very small. Behaviour of the elevators and rudders has proven very satisfactory.

As is well known, intensive effort is being applied to suppress the noise from the tip jet units during take-off and landing. Various experimental silencers have given very promising results, and the company state that they have "every expectation that when the silencers have been fully developed the aircraft will gain complete public acceptance from the noise aspect." Vibration within the cabin is generally of low amplitude, the level decreasing with increase in forward speed as the rotor power and collective pitch are reduced. The prototype XE 521 is comprehensively instrumented. Structural loads are measured by several hundred strain-gauges both on the airframe and rotor, and the excellent results obtained represent a major technical achievement. Three auto-observer panels are fitted, human observers scanning the essential instruments. A close check has been kept on fluctuating stresses, vibration and blade behaviour, so that, in conjunction with laboratory fatigue tests, clearance can be granted for the next stage in expanding the performance envelope.

Forward speed has been progressively increased to 155 m.p.h. (by no means the maximum) and the following are the results so far obtained in other major parameters of performance: vertical rate of climb, 1,300ft/min at partial power; forward climb, 2,400ft/min at partial power; maximum altitude, 7,000ft; maximum weight, 33,500 lb (500 lb above the design weight for the first prototype, but 5,500 lb less than that for the more powerful production machine). Comprehensive performance tests have yet to be undertaken, but Fairey announce that present indications are that hovering performance and vertical climb are considerably better than predicted.



Complete tip jet unit fitted with an experimental silencer. Air is supplied through the stack of three pipes.

The first successful transition from helicopter flight to autogyro flight was achieved at 7,000ft on April 10. Conversion took place in straight and level flight and resulted in no disturbance from the programmed flight-path. This achievement is the culmination of the initial stage of Rotodyne flight development, which so far has amply rewarded the immense effort expended during arduous months of rig testing and laboratory research.

THE AIRCRAFT INDUSTRY DEBATE (continued from page 760)

Supply): "I regret very much to say that I cannot see any prospect of any major Government production order for the Gloster Aircraft Company after its present order for Javelin fighters has been completed. We have given what assistance we can to the company by allowing it, in agreement with the Air Ministry, to reduce its rate of production so as to spin out its work."

MR. IAN MIKARDO (Lab., Reading): "Rationalization is made extremely difficult because the industry is notoriously non-co-operative, an industry consisting of highly individualistic firms, some of them run by highly individualistic gentlemen—some of us know some of them—who are not good at co-operating with one another."

"It is no good the Minister piously exhorting the industry and saying that it must think 'long and large' . . . The whole experience of this industry is that it thinks short and petty, and selfishly, too. There is no co-operation between one and the other. I know a good many businessmen all over the world, but the only businessmen I know who have a greater propensity than the aircraft manufacturers to cut each other's throat are the traders in the bazaars in Baghdad. I do not know of any people running a serious industry in the Western world who are so furiously and outrageously competitive with each other."

Dr. Barnes Wallis and the Vickers "Swallow." MR. AUBREY JONES: "It may well be that the Americans may feel disposed to grant Mutual Aid for the project. I do not know. At the moment, there is joint consideration of the proposal with a view to a joint arrangement under which the Americans would make their contribution under Mutual Aid."

"I am perfectly prepared to make obeisance to the geniuses, but I think that geniuses must occasionally recognize that they strain the wishes of their best friends if they remain persistently scornful of the practical. So much for the Swallow aircraft."

MAJ. LEGGE-BOURKE: "There is no man on earth who is more pained by the recent publicity than he [Dr. Barnes Wallis]. When I met him last September he was almost in despair . . . he believed he was on the brink of one of the most important discoveries of his life and at that moment the axe came down . . . Last September he gave the impression that this idea was so important to his mind that he could not allow himself to die with it inside him. He is over 70 years of age. This was an idea which he had to see developed while he was still alive. It was only natural that the place to which he should turn was a place where there is plenty of money and which is friendly, anyhow militarily, to us—the United States."

"Without any hesitation whatever, I say to the Government that if as a result of false advice or false economy Dr. Barnes Wallis is driven out of this country, I shall do my best for the rest of my life to find out who was responsible and expose him in the public eye. I have not the technical knowledge, nor do I pretend to have it, so I do not know whether this idea is capable of implementation in a practical form. All I know is that some 775,000 experiments had been carried out before I met Dr. Wallis . . . I want to congratulate the Minister of Defence for having kept the project going as long as he did, because he was not entirely helped by some people very close to Dr. Wallis during that period."

Supersonic Transport. MR. W. J. TAYLOR: "A programme of intensive research is being carried out into the various possibilities for a supersonic civil transport aircraft. The main airframe and aero-engine manufacturers are engaged in this research under the direction of the Royal Aircraft Establishment at Farnborough . . . The programme will continue so long as it is necessary and fruitful. If it is established that a supersonic airliner can be an economic proposition, consideration will then be given to the question of its development. We appreciate that if such an ambitious project were embarked upon it might well prove to be one for which some Government aid is essential. No one doubts that a supersonic transport aircraft is feasible. The problem is whether it can be economic. A joint study of this is being made by the industry and the Royal Aircraft Establishment at Farnborough and we hope for an answer in about 12 to 18 months. That is the state of progress. If the answer is favourable, it will then be a matter for arrangement with suitably powerful groups manufacturing airframes and engines to produce a practicable design, and it will be at that point that the question of Government assistance will arise."

THE A.W.A SEASLUG

Already fired under service conditions, the A.W.A. Seaslug is the Royal Navy's first ship-to-air missile. Powered by a sustainer motor and four boosts, the Seaslug engages bombers at any height up to the maximum at which modern aircraft can fly. It is fired at individual aircraft selected by long-range radar and the firing crew is far smaller than the crew of a gun turret in a major warship. The first ships of the Royal Navy to be equipped with the Seaslug are four County class fleet escorts, which are on order. The trial ship, H.M.S. "Girdle Ness", is now in service and has already carried out many successful firings at sea. The Seaslug has been designed, developed and constructed by Sir W. G. Armstrong Whitworth Aircraft Ltd., pioneers in guided missiles, in collaboration with the General Electric Co., Ltd. and the Sperry Gyroscope Co., Ltd.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD., BAGINTON, COVENTRY

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C

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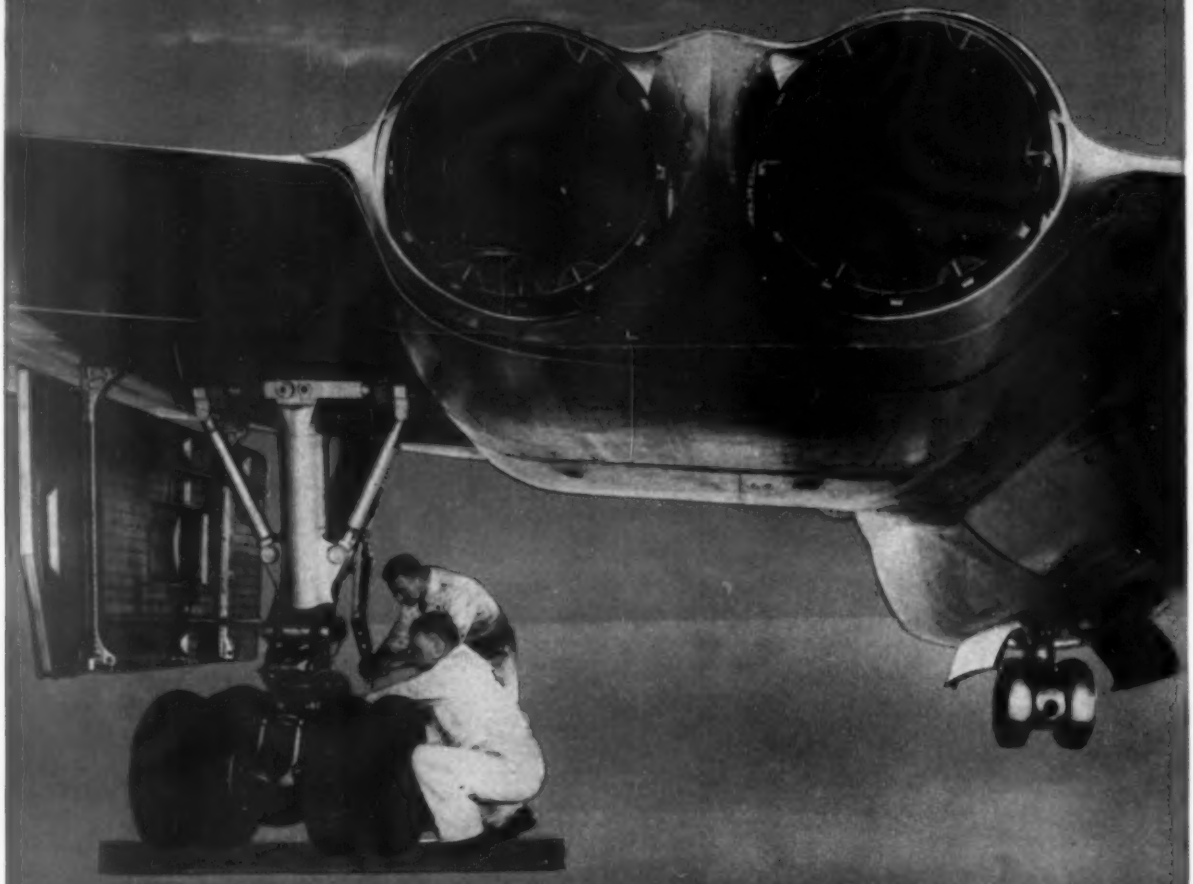

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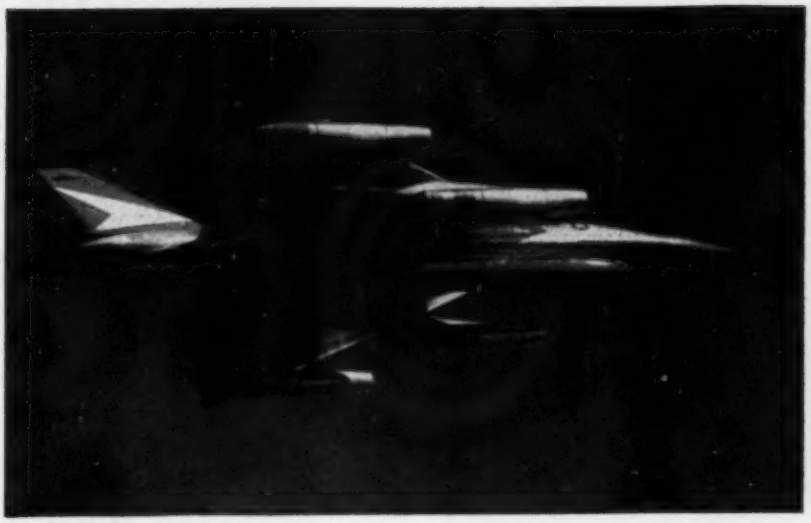
"Final bomber to appear was the B-58 Hustler, making a slow-speed fly-by. . . ."



Defense

Pt. 4: SOUND AND FURY AT THE FIREPOWER MEETING

By a Special Correspondent

THIS is the fourth dispatch from a correspondent who is a member of the party to which the U.S. Armed Services have given special facilities for inspecting their newest equipment and methods. His previous articles in the series appeared in our issues of May 2, 16 and 23.

BEFORE we left Offutt Field, General Griswold decided we should see the underground operational centre of S.A.C. Down we went to the communications centre, the teleprinter room and the computer set-up where every possible target has been checked electronically. Briefing for S.A.C. crews seems to be just a matter of producing the right punched card.

Every crewman knows just what his own particular objective would look like when he is within bombing range. A cleverly simulated radar display for every one of the many targets which S.A.C. would attend to if war should break out has been built up by intelligence men and trained radar interpreters. Crews memorize this display—an attention to detail which colours every aspect of S.A.C. training.

The world-wide radio net of the Command was demonstrated by an airman who in less than five minutes checked all communications from Ruislip to Tokyo. The General told me he could talk to any of the S.A.C. radio stations from his home, his car or his aeroplane.

Eglin Air Force Base was waiting for us, and so Capt. Jack Farar bundled us once more into his Convair. As we turned into the run-up position he warned us of thunderstorms around Memphis—storms which we couldn't completely avoid, despite radar help from Eglin. For ten minutes we bucked around in hail and lightning.

Half the U.S. Air Force seemed to have congregated at Eglin for the next day's Annual Firepower Meeting. And there were more to come, we were assured. Every air force base in the States seemed to have made an effort to be represented, and in addition civilian V.I.P.s from politics, trade and industry had been invited. In the officers' club I met a man whose business is soap and who wants to keep the Air Force clean. (When we visited Langley A.F.B. a disappointed officer told me that when the aircraft due to take a party from the base to this demonstration was at the end of the runway, the flight was cancelled. Eglin, already flooded with 160 big transports, simply refused to let them in.)

Major-General Robert Burns, commander at Eglin, was staging his last show. Soon he is to get his third star and make his H.Q. in Japan as C-in-C. The 90-minute display of death-dealing which he and his staff had planned was a disappointment for him, for Florida was having one of those bouts of bad weather which Americans find it difficult to explain not only to visiting firemen such as myself but to their own tourists. Certainly, as I sat in the stand with low cloud above and a chilly breeze around me, I thought of Farnborough.

But this affair was to be much more exciting—real blood-and-thunder stuff and a brilliant display of flying. Before I had time to feel cold, two long-nosed RF-101s charged towards us at 300ft with their cameras running. Eighty minutes later I was picking out the white dot which was me on a wet print which had been flown in by helicopter. As the two big, supersonic photo aircraft swept over the stand, a great blast of flame, smoke and dust to our right announced the thunderous departure of a Matador pilotless bomber for some target deep in the Gulf of Mexico. Two F-100s tagged on to it to make sure it behaved itself.

We were to have been the target for a formation of four F-102s, intent on deafening us with as many sonic booms. The commentator apologised on behalf of the weather, and said that the formation of big deltas would try to aim at us through the overcast—and this it did with some success. A Thunderchief (which was unhampered by greenhouse glass and susceptible nerves) followed this effort by flying straight across our front little higher than the top of the stand, and creating a most satisfying bang that almost lifted us from our seats. Later, the pilot—Capt. Howard W. Leaf—brought the same aircraft back to show what can be done with the M61 "Gatling" gun. It ruined the old Flying Fortress lying in the middle of the range and made me wonder exactly where the big fighter carried so much ammunition.

There were napalm attacks, simulated night photo missions, rocket demonstrations and bomb tossing. More F-101s gave us an excellent demonstration of how low cloud can aid the attack when this business of lobbing a bomb is used. But it removed the spectacle from the demonstration, for we were unable to see the smoke grenades attached to the bombs in order that their trajectory could be followed. The commentator made us Europeans smile a little grimly when he apologized once more: he was sorry the Air Force couldn't show us the real toss-bombing operation, but consideration for our safety prevented their using a nuclear weapon.

Sidewinder missiles were shown to us by an F-100—and convincing its behaviour was, first against a ground target and then in its regular air-to-air rôle. Another Flying Fortress, with a cluster of electric light bulbs as the heat source, was the ground target for this snake-like infra-red homer. One of the two Sidewinders released was dead on target, the second just short. In its second pass, the Super Sabre fired a target rocket and seconds later released a third Sidewinder. The missile overtook the rocket in spectacular fashion, and killed it very effectively. Good work, when you consider the target was only five inches in diameter.

Despite the overcast, three Super Sabres gallantly demonstrated their thirsty attachment to a KB-50 tanker—the latter festooned with piston engines, tanks, jet pods and hose-reel nacelles. That was the tactical refuelling demonstration. Almost at once, a B-52 showed us the strategic picture as it came in at 800ft behind a KC-135 Stratotanker. Later, I had the opportunity of inspecting the latter, whereupon I discovered that the Air Force has not only an effective aerial fuel station but a very capable troop carrier or freighter as well. Particularly when its proud owners remind you that it can carry some 180 people or twenty tons of stores, can remain airborne for sixteen hours and can fly at better than six hundred miles an hour.

Final bomber to appear was the B-58 Hustler, making a low-speed fly-by in front of the stands. It seemed but little bigger than some of the massive fighters we had seen, and was handled superbly by Maj. Fitzhugh L. Fulton, of the Air Research and Development Command. As the Hustler came in, the commentator told us: "Low and to your right is the only supersonic bomber of the jet age. . . ."

To end a memorable hour-and-a-half, the star-spangled Thunderbirds did their best in shocking weather conditions. These four Super Sabres from Tactical Air Command barnstorm the country as a visible display of the aerial teamwork the Air Force considers vital to its deterrent effort. The flying was dramatic, the commentary poor (Oliver Stewart, I thought, might well be exported under the mutual aid programme to help out).

(To be concluded)

Hucknall en Fête

THE R.A.F.A. DISPLAY

"Flight" Photographs

Treble-One Squadron's Hunters streaming smoke—a new refinement this year by the R.A.F.'s world-famous aerobatic team—during their splendid demonstration.

HUCKNALL airfield in Nottinghamshire is usually, one supposes, a reasonably secluded centre for Rolls-Royce and M.o.S. activities; but on Whit Monday, when the Eastern Area of the R.A.F.A. held its fourth display there, the airfield became the target for thousands of people from neighbouring towns. Nottingham, Leicester, Chesterfield, Derby and the whole clutch of surrounding Nottinghamshire and Derbyshire townships poured out their citizens upon it: and this enthusiastic Midland audience was amply rewarded both by the weather and the display.

As to the former, conditions were admirable, the morning cloud dispersing throughout the afternoon, leaving big blue patches and sunshine enough to make everybody in a "gate" of some 65,000 feel happy and comfortable—from a baby in arms who could not have heard of the R.A.F.A. to a very elderly lady whose appropriate vintage of aircraft was the Bristol Fighter rather than the Hunter 6.

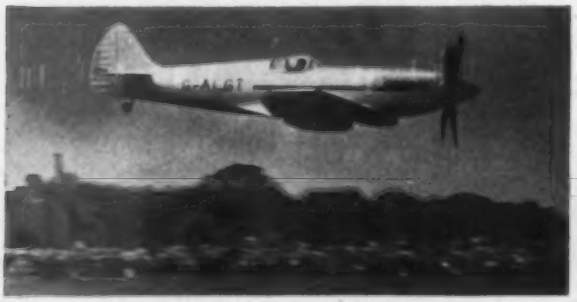
Already in the morning the Hucknall circuit was busy, both with visiting aircraft and with Derby Aviation's Dakotas, *Darley Dale* and *Dovedale*, which before and after the display did a roaring trade in ten-minute pleasure flights.

Flying started at 2 o'clock instead of 2.30 (for the convenience, apparently, of A.T.V. who were televising the occasion: life nowadays just has to be tailored to the telly) and at that time several hundred cars were still trying to get in along the B road which runs by the airfield; spectators who didn't intend to get in anyway had accommodated themselves in the surrounding woodlands and on a neighbouring slag heap, features which diversify this bit of Nottinghamshire countryside. Appropriately, after a delayed-opening parachute descent by Mike Reilly, the resident Conway-Vulcan was the first aircraft off—flown by A. J. Heyworth, the Rolls-Royce chief test pilot.

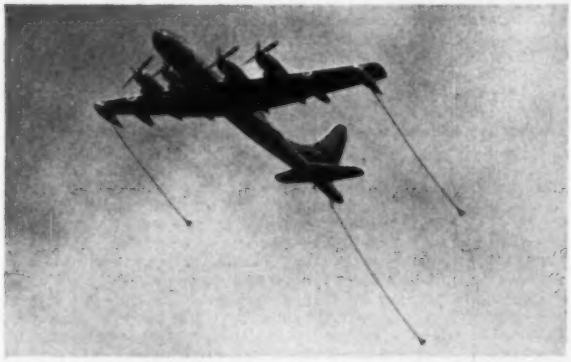
Thereafter there was an excellently varied performance for the next three hours, and it would be hard to say which of the turns pleased the eye and senses most. The R.A.F. acquitted itself with traditional dash and efficiency: there were the magnificent black Treble-one Squadron Hunter 6s with new refinements in their repertoire, use of blue smoke in a downward bomb-burst when the four broke away from the nine and in an upward bomb-burst (tangling into a smoky knot) at the end of their show, and Guards-like line abreast formation; the precise C.F.S. Jet Provost team showing what instructors can do; F/L. B. L. Robinson of No. 74 Sqn. deploying one of its Hunter 6s with two drop tanks in eight upward rolls; and F/L. R. E. Holloway, an instructor at No. 5 F.T.S., demonstrating just how good you have to be in a Vampire T.11 to win the R.A.F. aerobatic trophy. The U.S.A.F. made several rather sedate appearances: perhaps the most exciting was when three F-100s, each with an auxiliary fuel tank under the starboard wing, put in reheat consecutively (these bangs, as usual, being popularly thought to be sonic ones). Three B-66s flew over; three B-45s which did a low pass at the end of several higher ones effectively rocked anything within rolling distance; and the KB-50 flew around with its drogues out, as if hopefully waiting for somebody to come and refuel. The R.C.A.F. also participated, a Bristol Freighter of No. 137 Transport Flight dropping in from Langar, loading what looked like a half-section of boiler and then departing; and F/O. J. Law, of Nottingham U.A.S., made his Chipmunk look quite astonishingly fast in a low pass downwind. For the rest, the flying was done by civilians, with pride of place taken by Barry Radley of Hunting, who gave a first-class demonstration of the agility and speed of the A.S. Viper Jet Provost, including a nine-turn spin. There was a choice bit of historical perspective in the demonstration of a Spitfire 14 (which lives at Hucknall) by Mr. W. F. B. Willby of Rolls-Royce and of the Bristol Fighter D 8096 from the Shuttleworth Trust, flown by "Doc" Stewart of Boscombe Down. Parachute enthusiasts had their fill with three more drops, including one by Sue Burgess, who combines pluck with glamour in admirable Irish proportions; and for the glider enthusiasts there was an expert demonstration by F/L. K. R. Pearson (C.F.I. of the Northampton-shire Flying Club at Sywell) in a T.21c Sedbergh. In addition to these flying demonstrations there was a display of engines by Rolls-Royce; and in all nothing seemed to be lacking but helicopters and the Royal Navy. There could have been more crispness in the flying programme; things did not all happen in the published order; and the commentary was hardly audible to those in the private enclosure. But these are not complaints: this was a splendid show and the R.A.F.A. are to be congratulated on their enterprise and skill in organizing it. No doubt their charitable activities will benefit by even more than the £2,000 which was raised by the last display at Hucknall (two years ago) when 50,000 people attended.

H. W.

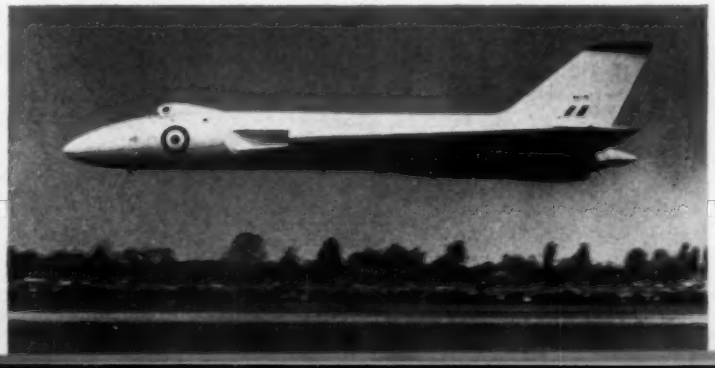
Left, the Spitfire 14 being demonstrated by Mr. W. F. B. Willby, a Rolls-Royce test pilot; and right, the Vampire T.11 flown by F/L. R. E. Holloway, of No. 5 F.T.S., this year's winner of the Wright Jubilee Trophy (for aerobatics), presented to the R.A.F. by the R.A.F.A. in 1953.



Above left, the red-and-white Hunting Jet Provosts of the C.F.S. aerobatic team in line astern; above right, three U.S.A.F. B-66s; below left, three Super Sabres with single auxiliary fuel tanks; and below right, the KB-50 tanker (four piston engines and two turbojets) with drogues out.



One of the three B-45s (above left) which came over from Alconbury; above right, the nine "Black Arrows" of No. 111 Sqn. in diamond formation; below left, an R.C.A.F. Bristol Freighter of No. 137 Transport Flight taking off after it had taken on board a section of steel boiler; and below right, the Conway-Vulcan making a low pass during its demonstration by A. J. Heyworth, Rolls-Royce chief test pilot.



Transatlantic Turbofans

DUCTED FANS FROM GENERAL ELECTRIC AND PRATT AND WHITNEY

SINCE the earliest days of Sir Frank Whittle and Power Jets (R. and D.), Ltd., it has been appreciated that the two common methods of adapting a gas turbine to aircraft propulsion represent the limiting members of what could be a broad spectrum of powerplants. The turbojet is light and simple, but, owing to its high efflux velocity, gives poor propulsive (Froude) efficiency for a vehicle whose cruising speed is substantially less than sonic; alternatively, the turboprop provides higher propulsive efficiency, but only at the expense of increased complication and inability to provide quiet propulsion at speeds greater than about 500 m.p.h.

Between the two, one can visualize a whole assortment of by-pass turbojets, ducted fans and shrouded turboprops, each of which can be shown to be the optimum prime mover for a particular sort of aeroplane (in particular, a big transport aeroplane). Rolls-Royce have pioneered in this field, and their family of Conway by-pass turbojets has encompassed engines with various by-pass ratios and with thrusts ranging from 9,250 to at least 17,250 lb. Conways at the latter rating are now in production for the Handley Page Victor B.2 and at a slightly lower rating for the Boeing 707-420, DC-8 and Vickers-Armstrongs VC.10. American engine builders have always watched the Conway keenly and are now realizing that, faced as they are with a progressive diminution in output for the armed forces, they must place greater emphasis on providing the optimum powerplant for the airline operator.

General Electric and Pratt and Whitney Aircraft have both been assiduously evolving turbofan versions of their accepted commercial turbojets. It is noteworthy that neither has attempted to produce a turbofan or by-pass engine from scratch; moreover, the two companies have produced quite different solutions.

General Electric's commercial engine is the CJ-805, which is in turn a variant of the military J79. Both engines were extensively described in our Powerplants of the World review issue of July 26 last. The basic gas producer has a 3-stage turbine joined by a conical shaft to a 17-stage compressor provided with variable-incidence blades on the first six stator rows. At maximum r.p.m. the pressure ratio is approximately 12.5 : 1 and, coupled with a moderate turbine-inlet temperature, this results in a minimum s.f.c. of about 0.73/0.74. Fully equipped, the current CJ-805 weighs 2,850/2,950 lb. Various versions are projected. The CJ-805-1 is rated at 10,500 lb and will be used in the CV-880 which has already been bought by several operators. Later versions will be more powerful, and include among their numerous improvements a turbine of 2in greater diameter.

The turbofan family begins with the CJ-805-21, several examples of which are already running on the bench at Evendale. G.E. have chosen to mount the fan behind the gas-generator, so that it consists of a self-contained and mechanically independent unit comprising an inner turbine working in the hot gas stream and an outer row of blades operating on atmospheric air—just like the pioneer Metrovick F.5, described in our issue of January 2, 1947. This arrangement removes some of the energy from the hot gas jet and thus greatly reduces the noise intensity (as described by Prof. E. J. Richards, *Flight*, May 30). The free fan will, however, require a duct of substantial diameter and, as its more highly stressed portions are hot, may pose some severe development problems.

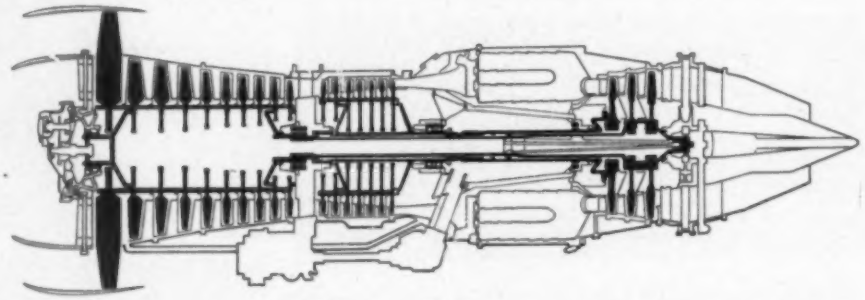
Recently the general manager of G.E.'s Aircraft Gas Turbine Division, Mr. J. B. Montgomery, stated that one of the principal reasons for choosing the rear-mounted fan was that this configuration permits retention of the basic turbojet and will make possible the conversion of existing CJ-805s. As we noted in our issue of July 26 last, the company are guaranteeing a parts-replacement cost of not more than $22 per flying hour during the two years following delivery to an operator (an arrangement similar to that offered by Allison for the 501 turboprop), and it is their intention to provide a conversion package—probably costing about $20,000—with which a basic turbojet can be brought up to −21 turbofan standard. C.A.A. certification is expected in mid-1960.

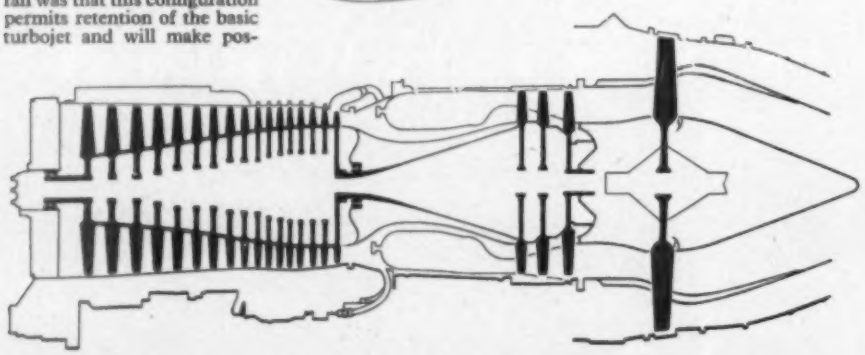
In contrast, Pratt and Whitney have adopted a configuration more akin to the Rolls-Royce by-pass formula. Rig testing has been conducted at Hartford on a variety of turbofan projects and it has been concluded that the best arrangement is to add a zero-stage (or two stages) fitted with extended blades operating in the manner of a ducted propeller. As the drawing shows, the Pratt and Whitney fan is mechanically driven from the front of the low-pressure compressor. This means that its operation will be less flexible than that of the G.E. fan, but it offers several advantages, notably that the fan is cold from root to tip.

Compared with the Rolls-Royce Conway, the Pratt and Whitney engine may have a higher by-pass ratio, but the pressure ratio of only one or two fan stages must be appreciably less than that provided by the several low-pressure stages in the Rolls-Royce engine. So far as is known, Pratt and Whitney have not added a third stage to the low-pressure turbine, but have obtained the extra shaft power merely by modification to the blading and perhaps strengthening of the inner drive-shaft and low-pressure spool. The simple drawing which appears here is unofficial, and should be regarded merely as a guide to the configuration adopted. The by-pass air is ejected as a propulsive jet immediately upon leaving the fan.

	CJ-805-1	CJ-805-21	JT3C-6	JT3D
Basic diameter (in)	32.5	49+	42	58+
Overall length (in)	132	170+	180	195+
Dry weight (lb)	2,850	3,150	4,050	5,000?
Maximum rating (lb)	10,500	14,200	12,500	16,750?
Minimum s.f.c.	0.74	0.67	0.81	0.685?
First delivery	1960	1961?	1958	1961?

All J57 airline derivatives are designated JT3, most of the simple turbojets so far sold to airlines being JT3C-5s or -6s. The new turbofan is designated JT3D and, although no statement has yet appeared from Hartford, it seems likely that Pratt and Whitney intend both to sell it as an engine in its own right and to provide conversion kits for earlier JT3s (it would admirably suit the KC-135 tanker). Present calculations indicate that the thrust-augmentation provided by the front fan will approximate to that obtained by the G.E. engine, namely 35 per cent. Assuming that peak r.p.m. are unchanged, this suggests initial JT3D ratings of the order of 15,500 to 17,500 lb. With this comes an improvement in s.f.c. by the surprisingly high figure of 15 per cent and—a factor of the first importance—a reduction in peak noise level of 10 decibels. Powerplant weight will obviously rise considerably and some figures are given in the accompanying table.





The fan of the Pratt and Whitney JT3D is mounted at the front and is mechanically driven. The fan can have more than one stage. The front-bearing loads are apparently transmitted through the fan shroud, which is of short chord.

In the General Electric CJ-805-21 the fan is mounted at the rear and is mechanically independent of the rest of the engine. Hot and cold jets issue from concentric nozzles.

UNDER STARTER'S ORDERS

The following:

Armstrong Siddeley Double Mamba in the Fairey Gannet AEW. Mk. 3

Rolls-Royce Tyne in the Canadair CL-44

Bristol Olympus in the Avro Vulcan

D.H. Gyron Junior in Blackburn NA.39

Rolls-Royce Avon in the Vickers Scimitar

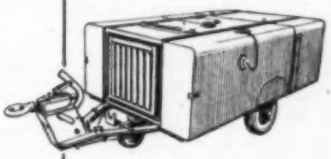
Rolls-Royce Avon in the D.H. Sea Vixen

Rolls-Royce Conway in the Handley Page Victor

Bristol Orpheus

Orenda Iroquois

Napier Eland



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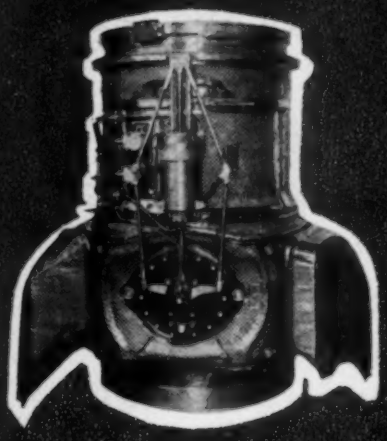
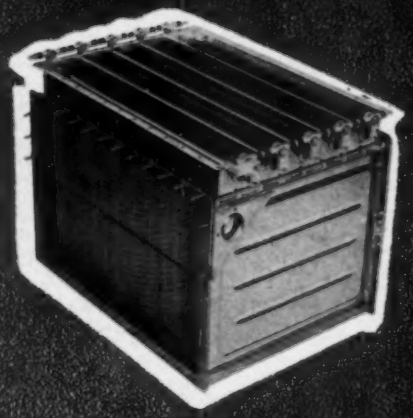


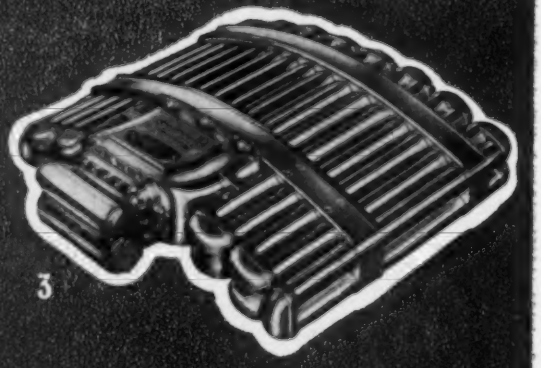
1

These thermal blankets are made of refractory fibre cased in .004 inch (.1016 mm) stainless steel. They are made-to-measure and are extremely light, the dimpled construction being responsible for their great strength. Specified for Rolls-Royce and Armstrong Siddeley jet and turbo-prop engines, these particular examples are shown fitted to the Rolls-Royce thrust reverser for the de Havilland Comet and Sud-Aviation Caravelle.



2

We design, manufacture and supply heat exchangers for many purposes in both aluminium alloy and stainless steel. This particular example is for the Vickers Vanguard's anti-icing system. Similar units are being supplied for the Fokker Friendship, the Bristol Britannia, the Armstrong Whitworth Freightliner and the Vickers Viscount.



3

High pressure fuel-cooled oil cooler for high performance gas turbine engines. This unit is used in the Armstrong Siddeley Sapphire S.A.7.

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The Future of Air Freighting

A NEW STUDY BY PROFESSOR BREWER

THE latest study to be prepared for the Boeing Airplane Company by Professor Stanley H. Brewer covers air freight movement between the United States and countries abroad. Entitled *U.S. International Air Cargo Future*, it is a sequel to the report published last November, *Air Cargo—The Next Ten Years* (its earlier title—*Report on Study of U.S. Domestic Market for Air Cargo, 1961-1965*—reflects more accurately the field covered). A synopsis of that report appeared in *Flight* of November 8, 1957.

The value of these reports can be measured against three quite distinct yardsticks: first, as an example of enlightened advertising; second, as an insight into the methodology of economic analysis; and third, as a source of information on the future flow of air traffic.

As a medium for sales-promotion these studies attain the highest levels of intelligence and sophistication. Although incalculable, the effect of this form of publicity must be considerable, both on the sales of freight-aircraft and of freight-services.

Calculation of potential air freight on the one hand and of estimated future freight on the other has called for quite distinct approaches in each case. Despite the public attention given to "created" demand for air freight (e.g., orchids that could not be marketed were it not for rapid air transport), Prof. Brewer assumes that "the greatest freight potential for the airplane is in movements now taking place" and has therefore based his predictions on a study of seaborne freight.

At the outset it was intended that the study would provide Boeing with a picture of commodity movements between specific points abroad and in the U.S. Budgetary limitations prevented this object being entirely satisfied: to ascertain the precise origin or termination point would have been too costly, so a compromise was reached by considering the traffic movement between 14 specified Customs districts in the U.S. and 17 world areas abroad. (This was found to account for about 90 per cent of U.S. seaborne foreign commerce in 1955.)

The basic source of information on commodity movements is the Customs declaration, copies of which are dispatched from Customs areas to the Bureau of Census (a branch of the Department of Commerce) where the data are tabulated on electric punch-cards. The Bureau of Census classifies imports into about 5,000 commodities (Schedule A) and exports into about 2,900 (Schedule B). To analyse such lists by commodity and by origin and destination would have been a task beyond the scope of Prof. Brewer's team, and so the study was based on Schedules S and T, in which the Bureau groups exports and imports into 188 and 163 broad categories. The immensity of the task is shown by the fact that the special tabulation of Schedules S and T supplied under contract by the Bureau to Boeing amounted to "several thousand pages of statistical information." From this tabulation it was possible to obtain a general picture of traffic movement by "category." A more specific picture (i.e., by "commodity") of particular traffic flows could be found by reference to Schedules A and B.

The next step was "selection of air potential candidates" by selecting those items for which average value exceed 70 cents per pound. To do this Prof. Brewer was given access to the information already obtained by the Aeronautical Research Foundation (on behalf of the U.S.A.F.) from a 10 per cent sampling of Schedules A and B for October 1954. Average air distances were then taken between each of the 14 U.S. Customs areas and 17 overseas areas, and then related to tonnages of high-value "air candidates" to obtain ton-mile figures for "potential" air freight. This was found to be only 1 per cent of either exports or imports, an amount seeming insignificant until it is seen to be some 50 times greater than the present air freight volume.

Calculation of estimated future freight traffic is based on projection of past trends rather than on a sample survey. Dealing first with the supply of air freight capacity, Prof. Brewer starts by analysing the pricing policy adopted by airlines. In the past the tendency has been to fix freight rates in the light of "what the traffic will bear." In the short-haul field this has usually led to freight rates being fixed at a level below total operating costs. Such a policy, based on the principle that freight is profitable to the airline as long as revenue exceeds the additional cost of providing the freight service, reflects the fact that most freight is still conveniently carried in the holds of passenger aircraft that would be operating whether or not freight was carried. But in the long-haul field the advent of specialized freighters (particularly the DC-6A and L.1049H) has led to a situation where "the newer aircraft being operated by such organizations as Seaboard and Western will carry substantial payloads at over-ocean ranges and are profitable to operate at rates considerably lower than those being charged." Prof. Brewer goes on to consider formula costs of the coming generation of freighters and the unsettling effect these aircraft will probably have on the I.A.T.A. price structure.

In determining the future demand for air freight, the value of total U.S. foreign trade is assessed by extrapolation of present values on the basis of official forecasts of Gross National Product or National Income (the degree of correlation between these parameters and value of foreign trade is remarkably high). Various average values per ton (based on past experience and future expectations) are then taken to develop tonnage estimates, and from these figures ton-mile data are established.

This examination of future supply and demand suggests that "an accelerated rate of growth can be expected in the coming seven-year period." In predicting traffic for 1961 and 1965, Prof. Brewer applies upper and lower growth rates of 32 and 27 per cent, and concludes that the volume of airfreight moving to and from the U.S. will rise from 210 million ton-miles in 1956 (148m by U.S. carriers, 40m by European carriers, 22m by others), to a median figure of 767m ton-miles in 1961 (max. 1,805m, min. 694m) and 2,180m ton-miles in 1965 (max. 2,555m, min. 842m). The basis of these predictions is well described in the report's admirable chapter summaries, set out below.

U.S. Exports. More than 100 million tons of freight, accounting for over 500 billion* ton-miles, were exported from the United States by vessel in 1955. This excludes small shipments and outbound in-transit movements. Nearly 80 per cent of this freight was exported from 14 large Customs districts on the East, Gulf and Pacific Coasts. The Northeast Atlantic Customs districts of Massachusetts, New York, Philadelphia, Maryland and Virginia exported a very large percentage of the United States totals.

The vast majority of the exported freight tons and ton-miles were accounted for by such products as coal, iron and steel, wheat, cotton, corn, petroleum and other items that are large in bulk and low in value. There is little or no air potential among these commodities.

A detailed sample that had been taken in 1954 was used to determine value ranges of commodities being exported. Approximately one per cent of the exports were found to have a value in excess of 70 cents/lb. This value was used as a minimum for potential air traffic when value alone is the criterion of whether or not a product can afford air movement. Of the commodities valued at 70 cents or more per lb, 48.06 per cent were valued between 70 cents and $1.00; 35.20 per cent from $1.00 to $2.00; 8.96 per cent from $2.00 to $5.00; and 7.68 per cent had a value of over $5.00/lb.

Although there are many determinants of whether or not products will be moved by air (i.e., perishability, emergency needs, lower inventories, less packaging, less handling, military expediency and others), the value criterion indicates that there is a possible potential at the present time in the general export market of nearly five billion ton-miles.

U.S. Imports. The total ton-miles of freight imported into the U.S. by vessel, with the exception of small shipments and inboard in-transit, exceeded 500 billion ton-miles in 1955. This was about equal to the ton-miles of exports.

There was even greater concentration of imports through a limited number of Customs districts than there were exports through those same districts. Approximately 88 per cent of the general United States imports by vessel arrived at 14 major United States Customs districts. By far the heaviest concentration of United States imports was through the major North Atlantic Customs districts.

Using the same criteria of values as in exports, there were approximately five billion ton-miles of traffic that were valued at 70 cents or more per lb among the general imports.

Although the export traffic that showed some potential as air cargo, using value as the primary basis, was fairly well balanced between Latin America, Europe and Asia, this was not true of imports. Asia showed a greater potential in ton-miles of high value items than either Europe or Latin America. The primary reason for this was the fact that most of the high value imports from the Asiatic countries entered the United States through the major North Atlantic ports and the long distances from that area of the world pushed the ton-mile figure upward. Europe was a strong second as an area of the world for developing air potential in United States imports and Latin America and Africa were found to be shipping relatively small amounts of these commodities in 1955.

Measurement of air potential cargoes must be, and is, rough indeed when a single criterion is used. With more than 500 billion ton-miles of import freight to study, the determination that only one per cent of this has any potential for air movement is real conservatism. If the air carriers were to capture but one-fifth of this one per cent in the next decade, they would be moving more than one billion ton-miles into the United States.

In-transit Shipments. More than 25 billion pounds of in-transit freight were moved in and out of the United States during 1955. This was traffic that arrived from one foreign country and was destined to another. Nearly 21 billion pounds of this was crude petroleum.

As with other world movements, a very high percentage of this traffic was in basic, low-value commodities moved in bulk at low steamship rates and showing little potential for air movement. In-transit traffic was, however, found to be worth analysis for air candidates as much of it moves very long distances.

Excluding the crude petroleum movement, 11.14 per cent of the inbound in-transit and 7.15 per cent of the outbound in-transit traffic had

**American billion equals 1,000 million.*

THE FUTURE OF AIR FREIGHTING . . .

an average value of 60 cents/lb or more. Since these values were computed from gross shipping weights they are understated by varying amounts, depending on the amount of packaging.

Nearly 85 per cent of the United States inbound in-transit and almost 80 per cent of the outbound in-transit that was valued at 50 cents or over per pound was cleared through the New York Customs District. More than 55 per cent of this inbound traffic arrived from South and Central America and the Caribbean and 66.70 per cent of the outbound went to this same area. Europe received 20.28 per cent of the traffic out of New York and contributed 22.3 per cent of the traffic into that Customs District. Africa and Asia are responsible for lesser tonnages; but their ton-mile contributions, because of the extreme distance, are substantial.

A total of nearly 600 million ton-miles of in-transit traffic valued in excess of 50 cents/lb passed through New York in 1955. A large part of this traffic can definitely be considered air potential for the future.

. **Small Shipments.** There are nearly 2.4 billion ton-miles of traffic that move in this category between the United States and various world areas. It is estimated that approximately 50 per cent of this small-shipment traffic now can be called air cargo potential and that in the next seven years, this kind of traffic will increase more rapidly than will foreign trade in general. The potential air cargo traffic to be found in small shipments, as defined by the Bureau of the Census, may reach about 1,500 million ton-miles by 1965. Smaller shipments of less than $100 in value were not sampled by the Bureau of the Census for this study. The air potential in this type of traffic must also be very large. Judging from the amount of this traffic that moves domestically, there may be as much as 250 million ton-miles of traffic moved between the United States and world areas in shipments valued at less than $100. Almost all of this traffic might be termed air cargo potential in the next few years. A substantial industrial development is going on throughout the world. This results in a substantial growth in the movement of small shipments.

Origin and Destination. A great deal of costly research would be necessary to trace overseas shipments of air cargo and potential air cargo to interior origins and destinations; however, this research is necessary to determine the most likely points at which air cargo can be economically consolidated for future movement.

Relationship of Cost and Price. There is greater elasticity of demand for air freight service in the long haul than for the short haul. Although there is much greater tonnage moved by all means of transportation in the short haul than in the longer hauls, the greater potential for air freight is in the longer movements. The speed advantage of the airplane in these longer hauls creates the greatest amount of time utility. It is for this long haul that there is more value to the transportation service of the airplane when time is a factor. Therefore, although rates that only consider value of service are justified, greater attention will be given in the future to cost of service rates. Current trends in direct operating costs of transport aircraft is such that there may be substantial opportunities to reduce rates for longer hauls.

The greatest opportunity to exploit the advantages of the airplane in the movement of freight is in international transportation. The one serious limitation at present is aircraft range at maximum payload. As soon as an aircraft is produced that can carry a near-maximum payload at a 3,000 mile or more range and at direct operating costs approximating to four to five cents per ton-mile, a very substantial amount of traffic will be developed.

The manner in which indirect costs are allocated to direct costs can materially affect the shape of the total cost curve. A percentage allocation will make the total cost curve incline sharply as distance increases, but this is not necessarily a true picture of costs. Allocation of indirect costs as a fixed amount flattens the curve for the greater distances and may result in just as large a recovery of indirect costs. If the advantages of the airplane and its full potential for air freight movement are to be realized, price must ultimately be tied to cost of service rather than value of service. The problem of allocating indirect costs to direct costs should be attacked in the light of how much business at what ranges the operators hope to attract. Long-haul, high-volume movements are more profitable than short-haul, small-volume shipments. The small shipments in both the short and long haul are excellent prospects for the combination aircraft operating on a scheduled basis. The long-haul, high-volume business can only be handled in all-cargo airplanes.

Much of the over-ocean freight originates and terminates at interior points. Multiple handling—in movements to ports, in and out of holds of vessels, and away from ports—is very costly. In addition to costs, these operations are time consuming. The airplane is beginning to be more competitive with the steamship for small shipments. As the world industrializes, there will be greater need for emergency shipments of parts to repair machinery. Some of these factors are showing up in the growth and development of air freight at the present time. The rate structure of the international carriers is weakening, in spite of rising levels of transportation costs elsewhere. Undoubtedly, this is a reflection of the intense competition that is developing between airlines and the levelling of direct operating costs for the longer distances. As a greater volume of freight is attracted to the airlines, allowing them to start additional all-cargo flights with a substantial load factor, international freight rates will come down: I.A.T.A. has been able to keep international rates under control up to now, but not all carriers belong to this organization. As aircraft become available to non-member operators who can operate economically, rates will be cut in order to increase profits. Because the newer airplanes will have sufficient range and payload, there will be excellent opportunities to attract profitably substantial amounts of traffic in international transportation at rates well below those presently maintained.

Historical Trends. Growth patterns in United States international air cargo movement have followed the same general trends as those for the domestic carriers. There was healthy growth for several years after World War II, but as the Korean War developed growth in air cargo movements dropped. The growth of this air cargo started to pick up again in 1955 and the pace was accelerated in 1956 and 1957. (A number of foreign carriers have entered the United States market within the past few years, and since data are not available on their traffic the statistics for United States flag carriers alone may be misleading.)

Air cargo development in the United States international market has lagged somewhat behind that of the United States domestic market, but there is every reason to believe that aggressive carriers with the right kind of programmes can develop substantial tonnages in the future. The first of the certificated all-cargo carriers on the North Atlantic has increased freight traffic in a spectacular fashion in the two years the firm has been operating scheduled services.

Although steamship rates on quantity movements are far below attainable costs for moving bulk freight by air in the foreseeable future, rates on many small shipments are within competitive range of the air carriers.

Foreign Trade Forecast. There is excellent correlation between the value of United States foreign trade, gross national product and national income. This correlation of approximately 0.98 is an excellent basis for forecasting total value of foreign trade for the future.

Average values per pound fluctuate materially as the character of tonnage movements change in foreign trade. These fluctuations make it more difficult to forecast the total tonnage moved in United States Foreign Trade for the future.

Based on the latest and most reliable forecasts, gross national product will increase between 35.3 and 44.8 per cent from 1956 through 1965. The value of foreign trade will increase between 33.7 and 43.2 per cent and the weight of United States foreign trade will increase between 25.9 and 34.8 per cent during this same period.

Continued high levels of manufacturing activity throughout the world should create disproportionately higher levels of demand for air cargo transportation.

ROYAL AERO CLUB COMMITTEES

THE constitution of the various Royal Aero Club committees for 1958-59 has been announced. Details are given below, together with names of stewards, timekeepers and other competition officials and F.A.I. representatives.

The Committee

President.—Lord Brabazon of Tara.

Vice-Presidents.—S. Kenneth Davies, Capt. Sir Geoffrey de Havilland, Lord Gorell, Viscount Kemsley of Dropmore, Sir Frederick Handley-Page, Whitney W. Straight, The Duke of Sutherland.

Chairman.—Col. C. F. H. Gough.

Vice-Chairman.—Maj. J. Stewart.

Committee Members.—Capt. K. J. G. Bartlett, F. E. Buckell, J. G. Crammond, E. S. Greenwood, R. E. Hardingham, G/C. G. J. H. Jeffs, R. G. Kent, E. H. W. Lucas, L. A. Morgan, Maj. H. A. Petre, S. Scott-Hall, J. C. C. Taylor, Capt. R. H. Walmsley, A. Cdre. A. H. Wheeler, F. Woodhead.

Note: The chairman is an *ex-officio* member of all committees. The chairman of the finance committee is an *ex-officio* member of the house committee and the aviation committee.

Other Committees

Finance.—Capt. K. J. G. Bartlett, J. G. Crammond, S. Kenneth Davies, E. S. Greenwood, L. A. Morgan, Capt. R. H. Walmsley, A. Cdre. A. H. Wheeler, F. Woodhead.

Aviation.—F. E. Buckell, R. E. Hardingham, Maj. H. A. Petre, S. Scott-Hall, J. C. C. Taylor, A. Cdre. A. H. Wheeler, C. M. Colbeck, B. Collins, C. J. de Vere, H. Best-Devereux, J. J. Dykes, A. F. Houlberg, J. M. Houlder, Capt. V. A. M. Hunt, N. H. Jones, H. B. Lindsay, G/C. E. L. Mole, W. I. Scott-Hill, B. J. Snook, J. N. Somers, P. Q. Reiss, P. A. Wills.

House.—J. G. Crammond, E. H. W. Lucas, Maj. J. Stewart, Capt. R. H. Walmsley, L. R. E. Castlemaine, G. B. Fellows, J. C. Henry, S/L. C. K. Turner-Hughes, C. S. Watkinson.

Records, Racing and Competitions.—F. Buckell, G/C. G. J. H. Jeffs, E. S. Greenwood, S. Scott-Hall, A. Cdre. A. H. Wheeler, E. S. Bowyer, Capt. H. S. Broad, J. Cunningham, W. P. I. Fillingham, I. A. Forbes, Cdr. A. Goodfellow, D. J. Lyons, P. B. Mayne, R. R. Paine, J. K. Quill, F. Rowarth, J. N. Somers.

"Royal Aero Club Gazette."—R. G. Kent, E. H. W. Lucas, G. Dorman, J. J. Dykes.

Business Aircraft Users Committee.—E. S. Greenwood, Whitney W. Straight, Capt. R. H. Walmsley, G/C. D. R. S. Bader, J. M. Houlder, H. B. Lindsay, Maj. D. Constable-Maxwell, W. I. Scott-Hill.

Stewards of the Club

Lord Brabazon of Tara, Lord Gorell, Col. C. F. H. Gough, Maj. H. A. Petre, The Duke of Sutherland, F. Woodhead.

Officials for Records, Races and Competitions

Timekeepers.—P. B. Mayne (chief timekeeper), C. Audrey, Maj. J. W. Barber, Maj. A. L. Ebblewhite, A. J. Gibbons, Maj-Gen. A. H. Loughborough.

Handicappers.—F. Rowarth (consultant), D. J. Lyons (chief handicapper), C. M. Britland, W. J. Charnley, J. Ferguson.

F.A.I. Representatives

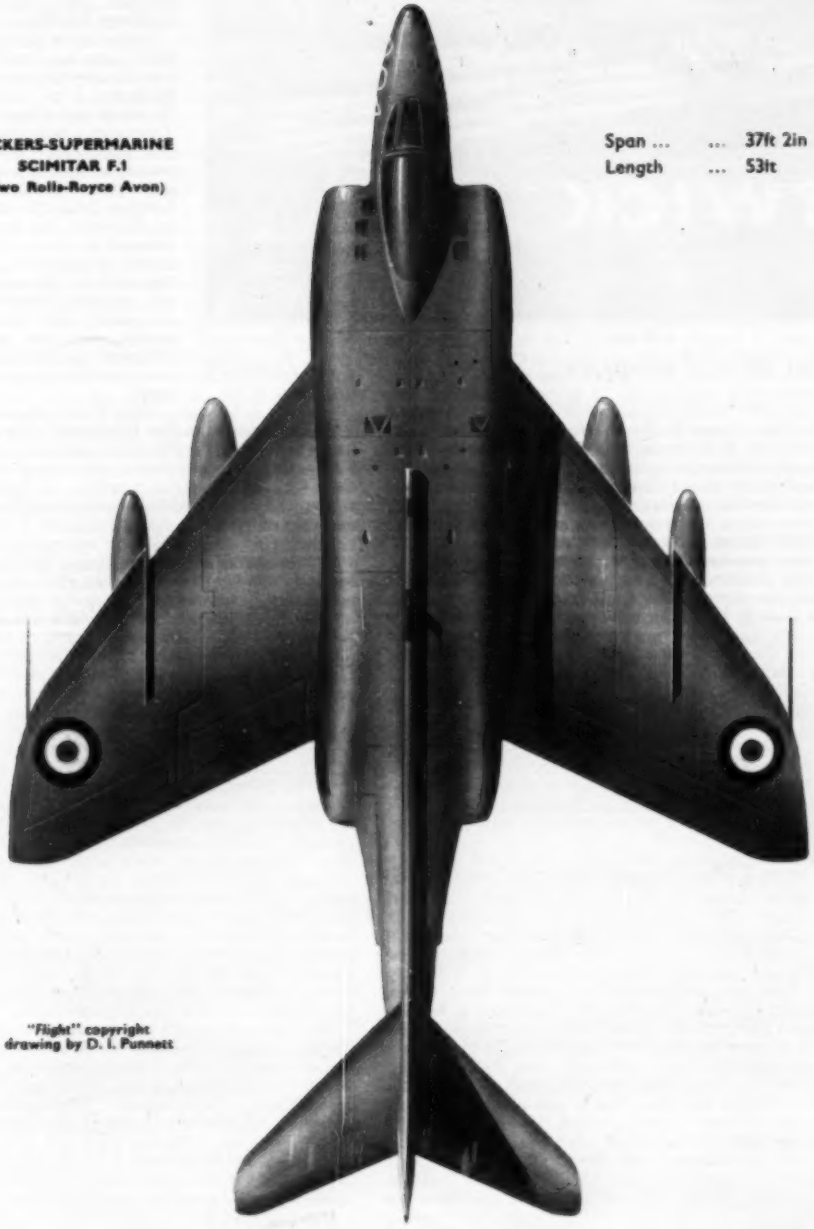
Capt. K. J. G. Bartlett (president of honour), S. Scott-Hall (sporting), P. A. Wills (gliding), Maj. T. W. Willans (parachuting), A. F. Houlberg (models), M. O. Imray (technical), Col. R. L. Preston (touring).

Other Representatives

M. O. Imray (British Gliding Association and Society of Model Aeronautical Engineers), J. C. C. Taylor (Popular Flying Association and Air League of the British Empire).

VICKERS-SUPERMARINE
SCIMITAR F.1
(Two Rolls-Royce Avon)

Span 37ft 2in
Length ... 53ft



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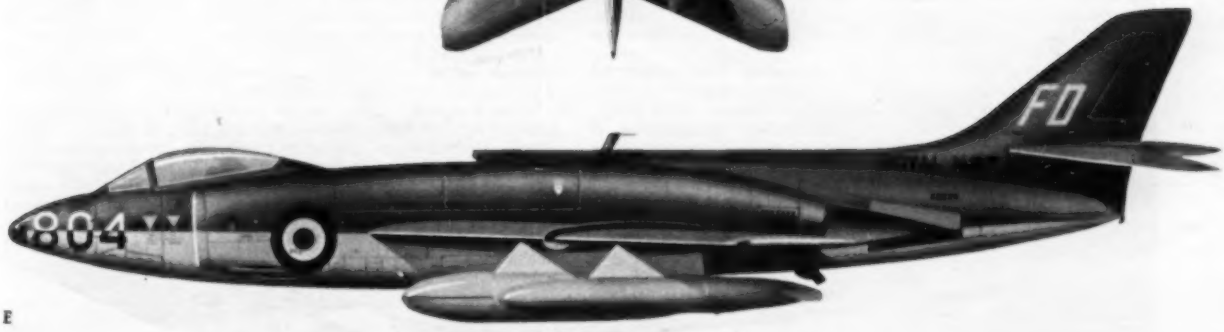
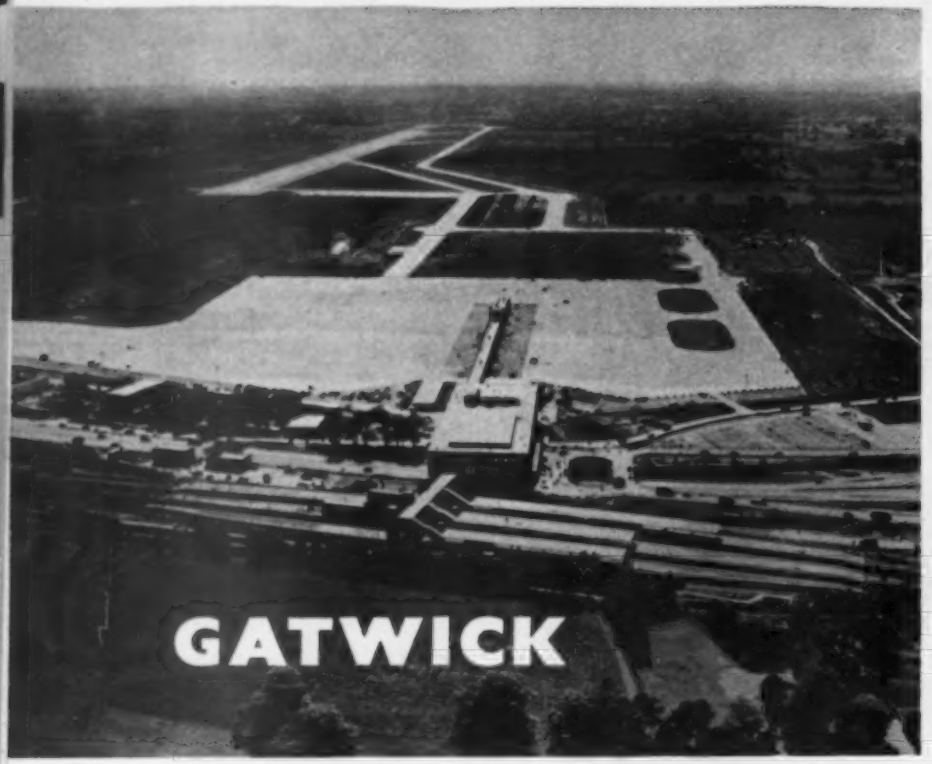




A westward view illustrating the transport confluence of road, rail and air at Gatwick.

GATWICK

Inauguration of a Two-airport System to Serve London

NEXT Monday, June 9, London's second airport—at Gatwick, Surrey, 25 miles south of the city centre—will be opened by Her Majesty the Queen. Scheduled services by British European Airways to the Channel Islands will start on the same day, although the first commercial use of the new airport was made by the independent operators Transair when a Viscount trooping flight from Malta arrived at their new base last Friday. The remaining fleet was transferred at the week-end.

After a troubled childhood and adolescence, Gatwick Airport can now celebrate its coming-of-age. Almost twenty-one years ago to a day, on June 6, 1936, Lord Swinton officiated at a ceremony at which a new lease of life was given to what previously had been no more than the base for the Surrey Aero Club. The new airport—judged even against some current standards—was revolutionary in design, and the "Martello-tower station" (later to become known as "the beehive") incorporated such radical developments as "extensible fingers" and a subway leading directly to a specially-built mainline railway station. In 1934 *Flight* had forecast that "a fast and frequent air service between Gatwick and the Continent should do well," and it came as no surprise when British Airways announced in 1936 that Gatwick was to be the headquarters for their rapidly expanding network of Continental services.

During the war Gatwick was extended and in 1946 emerged with two P.S.P. runways (one measuring 4,200ft, the other 3,600ft) and one 3,600ft grass runway. In October of that year the airport was requisitioned for the Ministry of Civil Aviation and designated as the officially sponsored airfield for the use of charter companies working in the London Area. It was with this in mind that the Ministry of Town and Country Planning decided in February 1947 to proceed with the development of Crawley New Town. Later that year the Crawley Development Corporation fiercely opposed a suggestion that the airport be extended, and the Ministry of Civil Aviation decided "to drop all idea of developing Gatwick for scheduled services." Although the Parliamentary Secretary to the M.C.A. twice made statements to the House of Commons during 1949 to the effect that it was not the Government's intention to develop Gatwick, when the Ministry postponed derequisition early the following year and B.E.A. officials expressed approval of retaining and developing Gatwick as a diversionary airport, it appeared that this site might well be expanded to cater for greater demand than that set by seven charter tenants.

In November 1950 the M.C.A. discussed plans with the Crawley Development Corporation concerning a £2¼m expansion of Gatwick, and although the Corporation opposed these plans, a year later the Minister told the Commons that "consideration is being given to the development of Gatwick as a bad-weather alternative for London Airport and as a base for some transport activities." By July 1952 Mr. Alan Lennox-Boyd was able to tell the House that the Government had selected Gatwick from a list of over 50 possible sites and intended to develop the airport as a southern alternative to L.A.P. Two months later the Ministry published preliminary details of the new project. These envisaged three runways (two major runways, 7,000ft long and 280ft wide, extending east-west, and a 5,000ft runway inclined N.E.-S.W.). Among other changes, this would have required a westbound diversion of the London-Brighton road. Work was planned to start in time to complete the northern of the two main runways and the terminal buildings by 1956.

This scheme provoked a storm of criticism, but it was not until the following summer that discussions were completed between the Ministry, local authorities, the Crawley Development Corporation and the British Transport Commission, and a White Paper was published. Both main runways were now to be shifted westwards by about half-a-mile (thus obviating the need for the London-Brighton road to by-pass the airport on the west), but no work was immediately planned on the northern runway. Stage 1, to be completed by 1958, would cover only the southern runway, the terminal buildings and eastward diversion of the main road to run along next to the railway line. This would cost £6m, while the second stage (primarily consisting of the second main runway), would cost a further £4m if embarked upon.

The White Paper aroused even greater criticism than the earlier Ministerial pronouncements, and even a leader writer of *The Times* was provoked to comment on *How Not To Do It*. The complaints culminated in a "spirited and sometimes rowdy" protest meeting at which Mr. Lennox-Boyd announced that a public inquiry would be held under the chairmanship of Sir Colin Campbell early in 1954.

When the Campbell Report was published in the following July a further storm of protest arose. Sir Colin concluded that the Ministry's contention regarding the suitability of Gatwick "was established," but emphasized that it was beyond the scope of the inquiry to decide whether Gatwick was the most suitable of the various possible alternative airports, or indeed whether development of an alternative to London Airport was actually necessary. Criticism now followed the line that development of new aircraft, particularly helicopters, would render Gatwick unnecessary, and that—in any case—a more efficient utilization of London Airport's facilities would allow any reasonable traffic increases to be handled there. Nevertheless, in October the new Minister of Transport and Civil Aviation, Mr. Boyd-Carpenter, announced that development of Gatwick was to proceed urgently.

Since then work has proceeded rapidly in order to complete the first stage by the deadline set for this summer. This has virtually involved constructing a new airport in two years. Until May 1956 the public were led to believe that the limit of £6m (a figure established by the Air Ministry Works Department as far back as 1952) would be maintained, but by October the estimate had grown to £6.6m, and by last December to £7.2m. When all invoices are paid, the capital cost will probably be close to £7½m, representing an excess of about 25 per cent on the original estimate. Against these figures must be set the Ministry's estimate of a net annual saving of £450,000 resulting from the closure of Northolt, Bovingdon, Croydon and Stansted.

The price of Gatwick—as London's second airport, as an airfield for the independent companies and as a base for an expansion of B.E.A.'s services—must be measured not only in terms of capital outlay balanced against annual savings, but in the loss of aerodrome real estate elsewhere. The arguments raised in objection to the rebirth of Gatwick have been suppressed, but not revoked, by the opening of the new airport. The problems of proximity to Crawley and Horley must be resolved as best they can, but the closing of another airport south of London—Croydon—cannot be justified by the small annual saving that it will bring. There is a growing need for a business aircraft airport for London, since Gatwick, for all its virtues of size, location and facility, is attuned to airline and not to executive needs.

It has always been claimed for Gatwick that, as a Continental gateway, it offered exceptional communication facilities. The old airport claimed to be "closest to London in travelling time" and "closest to Continent in flying time." "The quickest way" the Airports, Ltd., brochure used to proclaim, "is the rail-air way." And with the new terminal building sited adjacent to the rebuilt station (previously Gatwick Racecourse, now Gatwick Airport),

Gatwick's control tower is glazed with three thicknesses of glass, the outer of which is tinted against glare. The controller at the sloping console in the foreground is adjusting the airport lighting intensity.

the claim still holds good. The road journey from London, on the other hand, is less convenient, and cannot approach the 35 minutes taken between Victoria and Gatwick by fast train. Nevertheless, by no means do all passengers wish to travel from central London, and the new airport has been designed to accept a flow of passengers (and spectators) arriving both by rail and road. Gatwick Racecourse station has been lengthened to accommodate 12-carriage trains, and glazed overhead awnings have been added to cover the platforms. The terminal building is connected to the station by a covered footbridge which is traversed by passengers on their way into the terminal concourse. Airline passengers are responsible for their own baggage until they reach the airline desks in the terminal; there is no town terminal for Gatwick.

Providing road access to Gatwick has been a major undertaking. The London-Brighton road had in any case to be diverted to build the runway and a new stretch of double-track road, 2¼m long, now runs round the eastern perimeter of the airport. An admirable and undoubtedly very necessary separation of road traffic flows has been adopted, so that airport traffic is filtered off the main road and up an elevated ramp to a roundabout at the terminal entrance; in no direction is it necessary for a turn-off to be made to the right against on-coming traffic. The car park is at road level, so that cars depositing passengers may wait at the terminal entrance only sufficiently long to unload. The vehicles must then be driven down the ramp to the park and the driver, if he is a passenger, return the short distance to the terminal building on foot. There does seem to be some danger of congestion on the elevated roundabout at periods of peak activity with this system, and it would be a major task to extend the elevated roadways. This feature must remain among the unknown until operations are in full swing.

While with any new airport the overland communications tend to assume primary importance in the public eye, there have been special problems to overcome in determination of the best airborne approaches to the single runway.

A new airport in crowded south-east England was bound to present problems of air traffic control, and a study of *Air Pilot* shows that the best routing into and out of Gatwick must to some extent still be determined by the traffic pattern prevailing at the time. It had originally been intended to use twin holding points at Dunsfold radio range and Crowborough non-directional beacon, but only the Crowborough N.D.B. will now be used.

Determination of the traffic procedures at Gatwick has been undertaken at the M.T.C.A. air traffic control training school at Hurn. The school is equipped to simulate the whole United Kingdom traffic control pattern, and by adding suitable flight progress strips to the movements board, any number of air traffic situations can be simulated. An exercise introducing Gatwick into the pattern was run last October, and the procedures envisaged at that time were adjusted in the light of the subsequent analysis of the traffic handling. Since the majority of Gatwick's traffic will at first consist of B.E.A.'s services to the Channel Islands, the most frequented routes will be those to the south, but the Hurn exercise has been intended to establish procedures for skeletal routes radiating in all directions. A further plotting exercise was run at Hurn in April, both to prove the changes that had been made to the procedures and to familiarize Gatwick controllers.

There were obvious advantages in using both Crowborough and Dunsfold as A.T.C. holding points, as they are positioned respectively east and west of the single runway. But Dunsfold is the main joining and converging point for London Airport and perhaps the busiest of all the transfer points from the London Control Area on to the airways system. To use it as a holding point for Gatwick as well—particularly when the volume of traffic increases—might have made things difficult for London Airport control and have prejudiced the radar climb-outs over Dunsfold.

Crowborough N.D.B. is also used by London Airport traffic, particularly on the heavily loaded route between Paris and London. The procedure for traffic coming into London along airway Amber 2 has previously been to swing off to the left from Lydd to cross Crowborough *en route* to the L.A.P. holding point at Epsom, but now that Gatwick is in use, aircraft approaching on the re-aligned Amber 2 airway will avoid Crowborough by continuing to the new

Gatwick claims access to its terminal building at least as convenient as any other airport in the world. The terminal could be extended both vertically and horizontally, in which case two additional glazed fingers would be added on the apron each side of the existing pier.

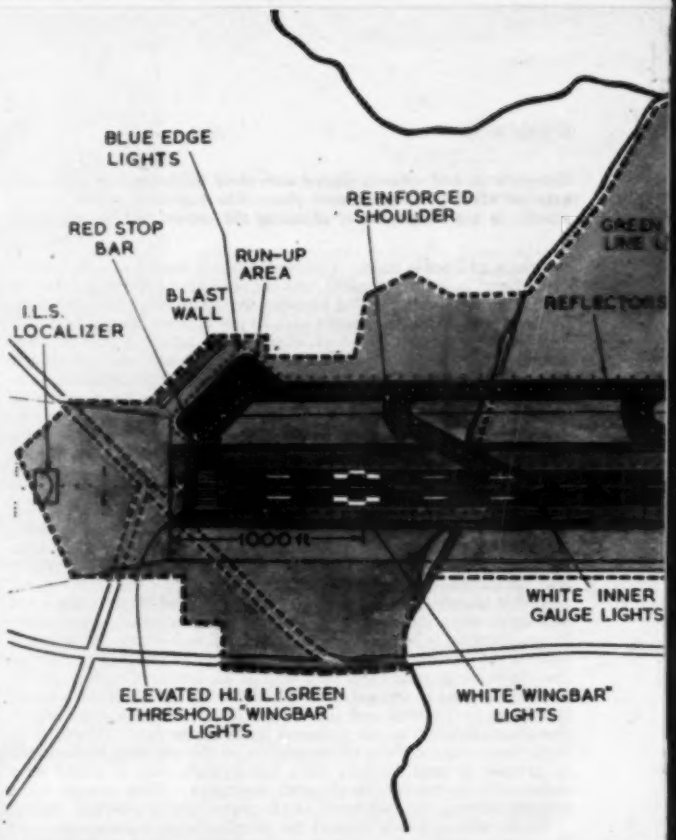
"Flight" photograph

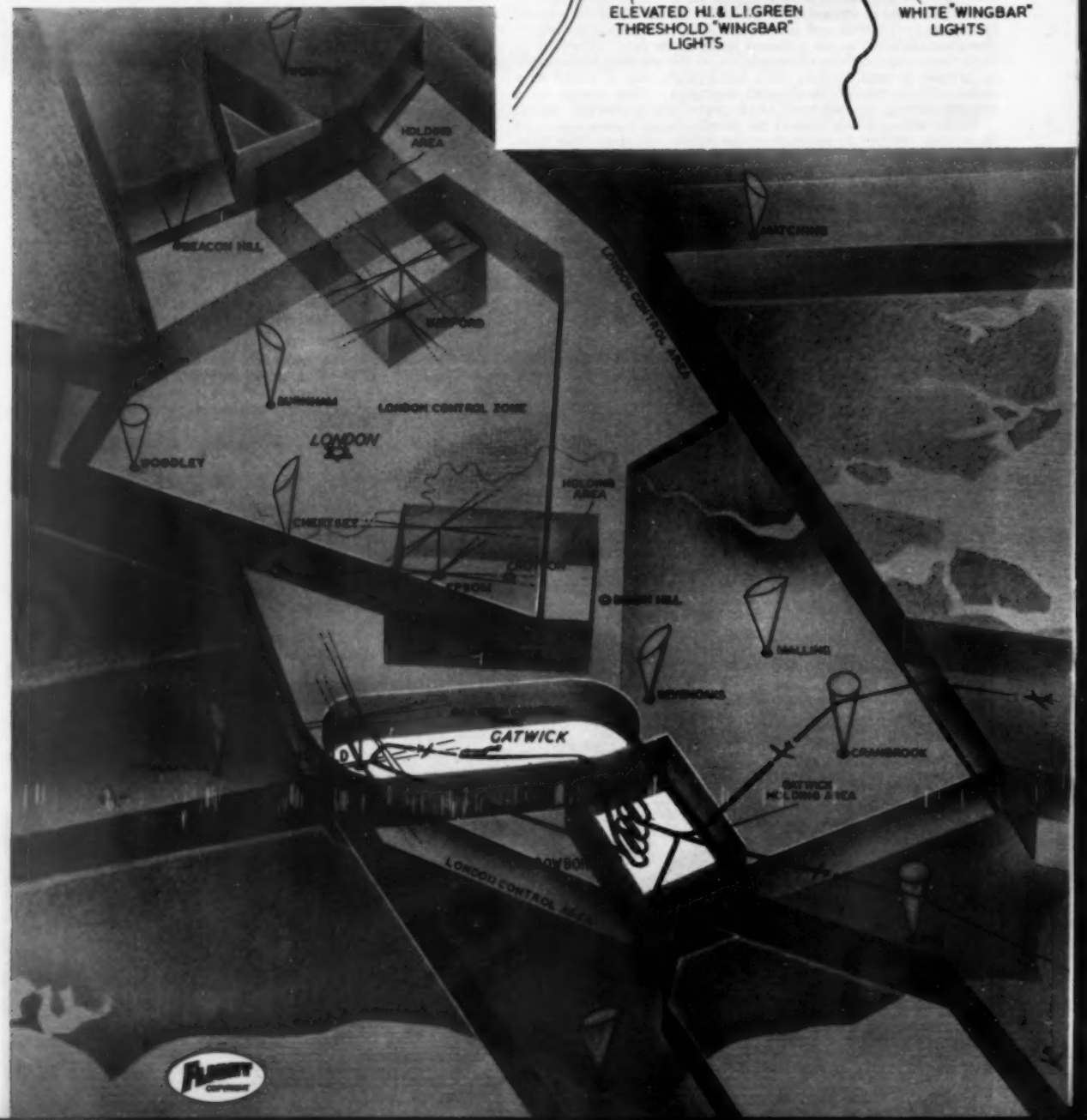
GATWICK . . .

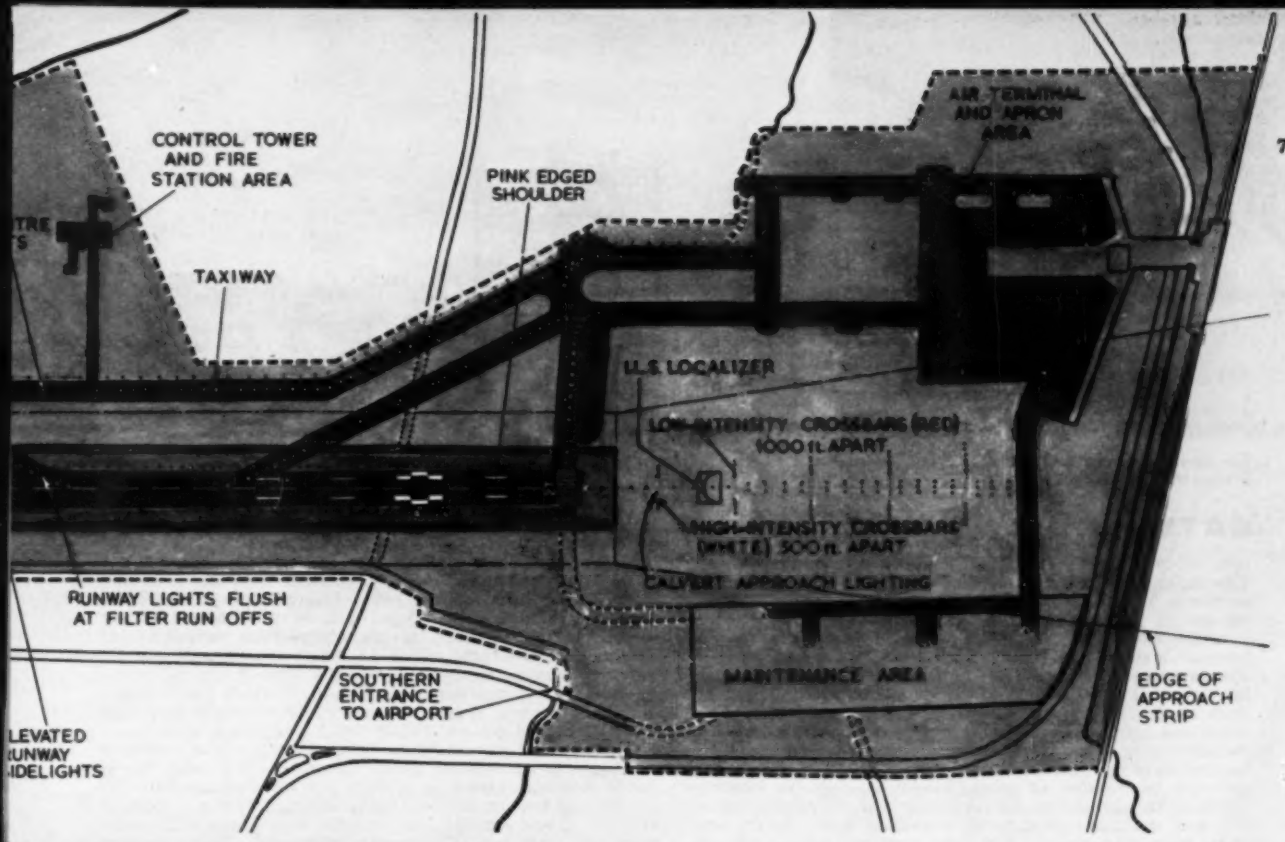
Cranbrook N.D.B. before joining the Epsom stack. This is not quite all the story, because air traffic control must, in practice, be very much more flexible than the rather general procedures that are laid down as guiding regulations in *Air Pilot*. When Gatwick traffic is not too heavy, for example, London Airport control may continue to make use of Crowborough for outbound traffic, and two new outbound "on request" reporting points—Fairoaks and Biggin intersections—facilitate outbound clearances from L.A.P.

Aircraft going into Gatwick now start their approach procedures from the reporting points at Rye N.D.B. (from the S.E.), Seaford fan marker (from the south), Cranbrook N.D.B. (from the north or N.E.) or Dunsfold, approaching Crowborough on a track of 330 deg where the familiar one minute racetrack pattern is flown in the stack. Special precautions have been taken to avoid traffic crossing the New Town at Crawley.

From the bottom of the Crowborough stack, which is at 4,000ft, aircraft are guided on to the final approach path by beacon sequence or by radar, the two procedures being similar but not identical. Aircraft not being sequenced by surveillance radar and landing on the 27 direction of the runway leave the stack at 4,000ft, fly due north from Crowborough descending to 2,000ft and then make a turn to the left to intercept the I.L.S. localizer






CONTROL TOWER AND FIRE STATION AREA
PINK EDGED SHOULDER
AIR TERMINAL AND APRON AREA
TAXIWAY
I.L.S. LOCALIZER
LOW-INTENSITY CROSSBARS (RED) 1000 ft. APART
HIGH-INTENSITY CROSSBARS (WHITE) 500 ft. APART
CALVERT APPROACH LIGHTING
RUNWAY LIGHTS FLUSH AT FILTER RUN OFFS
SOUTHERN ENTRANCE TO AIRPORT
MAINTENANCE AREA
EDGE OF APPROACH STRIP

The two illustrations on this page show the pilot's Gatwick—the complex of radio aids, holding beacons, approach paths and runway markings and lighting. The opening of Gatwick and its control zone has left very little of South-East England that is not now controlled airspace in instrument weather.

course as soon as the needle indicates a swing to the blue segment. On the three degree glide path of the I.L.S. the outer marker (at 423 n.m. from the threshold) is crossed at 1,380ft and the middle marker (4,780ft from the threshold) at 235ft. The procedure for landing on the 09 direction of the runway is to descend to 3,000ft in the stack and then head westwards on a track of 280 deg for two minutes before descending to 2,500ft. A precisely defined track has been stipulated to keep traffic, as far as possible, clear of Crawley New Town, and surveillance radar will also be used to help controllers to keep inbound aircraft on track. This leg is maintained until two minutes after intercepting the south-east leg of the Dunsfold range, where the aircraft turns due north and then east to pick up the I.L.S. localizer beam. An outer marker 4.16 n.m. from the threshold and a middle marker, crossed at 1,400ft and 310ft respectively, provide the distance-to-go references.

Very much the same procedure is adopted for a radar approach; Cossor ACR 6, Marconi Type 232 surveillance radar or the G.C.A. search element is used to bring aircraft off the bottom of the "one minute racetrack" stack pattern at Crowborough beacon to within 8 n.m. from touchdown, where it is taken over by the G.C.A. precision approach radar.

The tracks followed by outbound aircraft from Gatwick are not shown on the airways diagram (left), since the actual routing will depend upon that preferred by the pilot and the situation prevailing at the time—in general, outbound tracks are routed *via* Crowborough or Dunsfold.

After landing, aircraft leave the runway along the high speed turn-offs to the taxi tracks. The most frequently used runway direction will be 27 (true direction 257 deg 30 min); there are two intermediate turn-offs in this direction and one in the easterly direction. A uni-directional traffic flow is maintained on the aprons with the direction dependent upon the runway in use; the route to be followed is indicated by runway direction boards and the number of the parking stand to be occupied is passed to the aircraft by R/T. From the apron entrance arriving aircraft follow the appropriate white centre line painted on the apron taxiway until they are opposite their allotted stand. Nosewheel guide and stop lines are painted on each stand and the stand number is indicated by black figures on a yellow background, which are lit by blue neon lighting at night or in poor visibility.

There are a total of 18 parking stands, 11 around the central pier and seven to the south and north of the pier. There is also an "island" parking site to the south of the pier (to which passengers will be taken by an airport bus) which could accommodate additional aircraft if necessary.

Passengers arriving at Gatwick airport by road or rail pass through respective entrances into the lofty concourse of the main

Commandant of the new airport is Mr. B. A. Oakley. (Below) An S-55 of B.E.A.'s helicopter unit was used to place in position Gatwick's rotating beacon on top of its 85ft tower. It flashes a green "G.W."

The single finger extending out on to the apron is 900ft long. On the left is the upper storey, partitioned for customs and non-customs passengers. On the right is shown the aircraft marshalling tower and parking stands along the finger. "Flight" photographs

GATWICK . . .

terminal building, the floor of which is 22ft above ground level. The building is of concrete, clad in glass and steel, and the architects, Yorke, Rosenberg and Mardall, have adopted an original design. A minimum of decoration has been applied to the structure of the terminal, which is intended to convey an impression of strength and spaciousness from the building materials used in the construction. The supporting pillars, for example, are left untreated after casting and the pre-cast concrete slabs of the walls are left in unadorned contrast to the glass expanse of the south wall. Such colour as there is in the concourse will come from the advertising displays on the central concessions block, the heading boards of the facilities around the sides of the hall, and that provided by the flow of people moving through the building.

Facing the entrance to the concourse from the railway station is a long staircase leading to the restaurant floor. At the head of the stairs is a substantial buffet and snack bar, beyond it a cocktail bar and beyond the bar the main restaurant.

A subtle change in the character of the interior design takes place on the restaurant floor. The noise and bustle of the main concourse has intentionally not been in any way subdued; the architects visualize the passage of travellers as part of the character of the building. But on the restaurant floor, in contrast to the almost stark simplicity of the main concourse, decoration has been progressively introduced to provide graded luxury. The buffet, for example, has red Terrazzo tiled walls and green Terrazzo floor, and the cocktail bar and restaurant beyond it is carpeted; the restaurant will be fully decorated, curtained, and soundproofed.

The process of departure from Gatwick begins with checking in baggage and showing tickets at the airline desks. Baggage is loaded on to a conveyor running behind the row of desks and taken on to the ground floor and hence to the waiting aircraft. Passengers are not subject to outward customs, although spot checks by customs officers may be made and emigration formalities must be observed. When called to join their aircraft, travellers descend to the mezzanine floor and go unescorted out along the pier to the aircraft stand. To walk from one end of the central finger to the other takes about seven to eight minutes, so that, including processing, it should be possible for passengers to arrive at the airport 20 min or a little less before boarding the aircraft. The finger is partitioned vertically so that international and domestic travellers are segregated for customs purposes once they have started the journey out to the aircraft.

Ample provision is made for spectators, who have access to the concourse, buffet and restaurant, and a viewing platform along the complete length of the central pier. In addition there is a spectators' enclosure at ground level to the north of the terminal.

Gatwick's most characteristic feature is unquestionably its single 7,000ft long, 150ft wide, runway. Lying roughly east and west, it is distinguishable from any other runway in the British Isles by the turn-offs on to the taxi track, which can safely be negotiated at 50-60 kt, and by the special treatment which has been applied to darken the surface. This has been done to reduce glare and to provide contrast with the white threshold, centre line and touchdown markings, and the pink-coloured 75ft wide shoulders. These have been continued across and beyond each threshold to provide an overrun 300ft wide and 200ft long that has a bearing strength approximately half that of the runway itself and equal to that of the taxiways. The top runway concrete, 12in thick, was laid in 15ft wide strips which were later sawn into 15ft lengths with fibreboard inserted to form contraction joints. The minimum crushing strength is 5,000 lb/sq in at 28 days and the bearing strength is sufficient for the 190,500 lb landing weight of a DC-8. The concrete top layer is laid upon a layer of polythene sheet, 0.003in thick, which serves as moisture insulation for the top slab and reduces the friction between upper and lower slabs. A considerable engineering operation was needed in order to complete the runway, shoulders and taxiways on time, particularly as special efforts were made to ensure that the runway was truly flat.

Runway markings—which conform to the latest I.C.A.O. recommendations—are shown on the drawing on p. 773. Apart from the usual threshold, direction and centreline markings, touchdown zone markings extend 2,000ft from each runway end, and are intended to emphasize the fixed-distance touchdown aiming points 1,000ft from the threshold. Cleared areas at least 900ft long have been provided beyond each threshold of the runway and the approaches—with two minor exceptions marked by red flashing beacons—come within I.C.A.O.'s recommendations for a clear instrument approach surface at a slope of 1 in 50.

The most modern airport in Europe, Gatwick has a highly developed lighting system that incorporates certain very new features installed as a result of M.T.C.A. and M.o.S. trials.

The approach lights are to the British Calvert type of centreline and bar. At the western end of the runway the centre line is 3,000ft long and is made up of white high intensity lights at 100ft spacing and low intensity red lights (supplied by G.E.C.) spaced at 200ft. There are two low- and five high-intensity crossbars spaced at 1,000ft and 500ft intervals respectively. The eastern end of the runway is similar except that the centre line of lights has been reduced in length by 200ft to clear the taxiway to the maintenance area. At each end of the runway one centre line light near the I.L.S. localizers is omitted.

Flush fitting runway lights have been abandoned in favour of Benjamin Electric high intensity lights raised 10½in above runway level. They are in two rows 100ft apart, spaced at 100ft intervals facing west, and 200ft facing east; supplementary low intensity lights are spaced at 200ft intervals and are omni-directional.

An innovation is the use of touchdown zone lighting covering the first 3,000ft of the runway in each direction; in other words, all but a 1,000ft in the centre of the runway. This comprises a series of short transverse bars each side of the centre line and 37ft 6in from it, each bar consisting of four lights having a maximum projection of ¼in and visible only to aircraft on final approach. The lights are intended to reduce the "black hole" effect experienced by pilots suddenly deprived of the intensity of the approach lights.

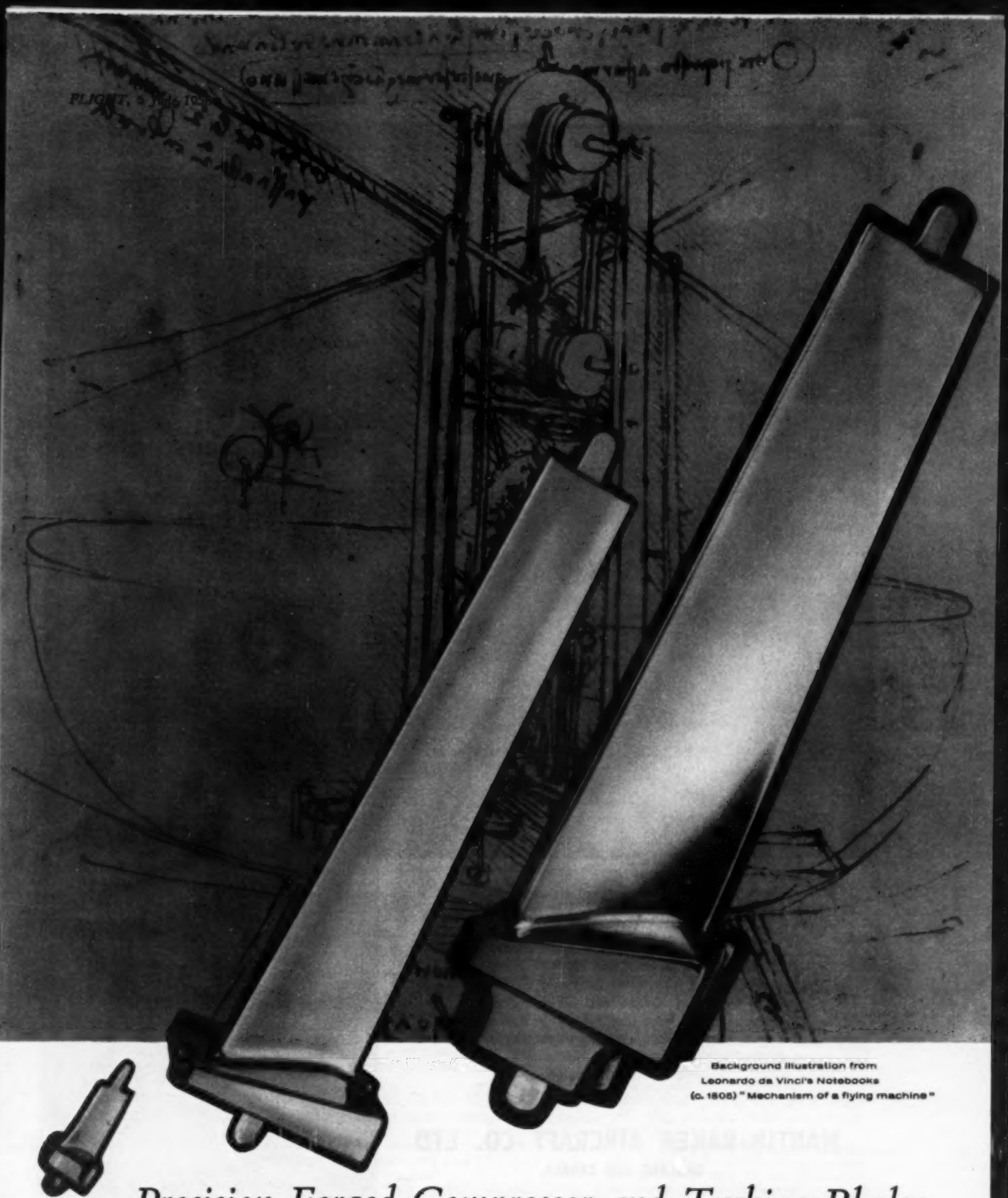
Apart from the standard G.E.C. green threshold lights, the Gatwick runway is equipped with high intensity green threshold wing bars consisting of four uni-directional elevated fittings on either side. Further wing bars are positioned at 1,000ft from the runway end adjacent to the touchdown zone bars.

The taxiway lighting has also received special treatment because of the nature of the high speed turn-offs. The centre lines are marked with rows of green lights which start from the runway centre line 160ft before the turn-off and continue at 80ft intervals or less along the turn-offs and down the taxiways. The green lights are supplemented with small yellow reflecting markers at the edge of the main taxiways. All approach, runway, threshold and green taxiway lighting is provided with brilliancy control, but until the airport has been in operation long enough for pilots' comments on brilliance of the various systems to be analysed, the intensity will remain a matter for experiment.

Lighting in the terminal area (apart from an enormous amount of interior lighting) is provided by floodlighting the apron and marking the edges with elevated blue lights. Gatwick also has a Stone-Chance identification beacon installed to the south of the western end of the runway which flashes a green "GW," and southern and northern hazard beacons. The northern 2.25 kW beacon, rotating at 9 r.p.m. to give 36 flashes a minute, is situated 3,000ft to the north of the extended centre line of the runway and the southern beacon is on the extended runway centre line 10,850ft from the threshold.

A feature of Gatwick that is particularly unusual is the siting of the control tower and adjacent fire station out of sight (or very nearly so) from the terminal buildings. The position that has been chosen, about half-way along the runway and standing back 1,640ft, is a concession to the need for a single control tower to cover both stage one and stage two of Gatwick's development. Nevertheless, the control tower is one of the few physical indications that a second runway is contemplated. Within the building

(*Concluded in col. 2, page 785*)



Background illustration from
Leonardo da Vinci's Notebooks
(c. 1505) "Mechanism of a flying machine"

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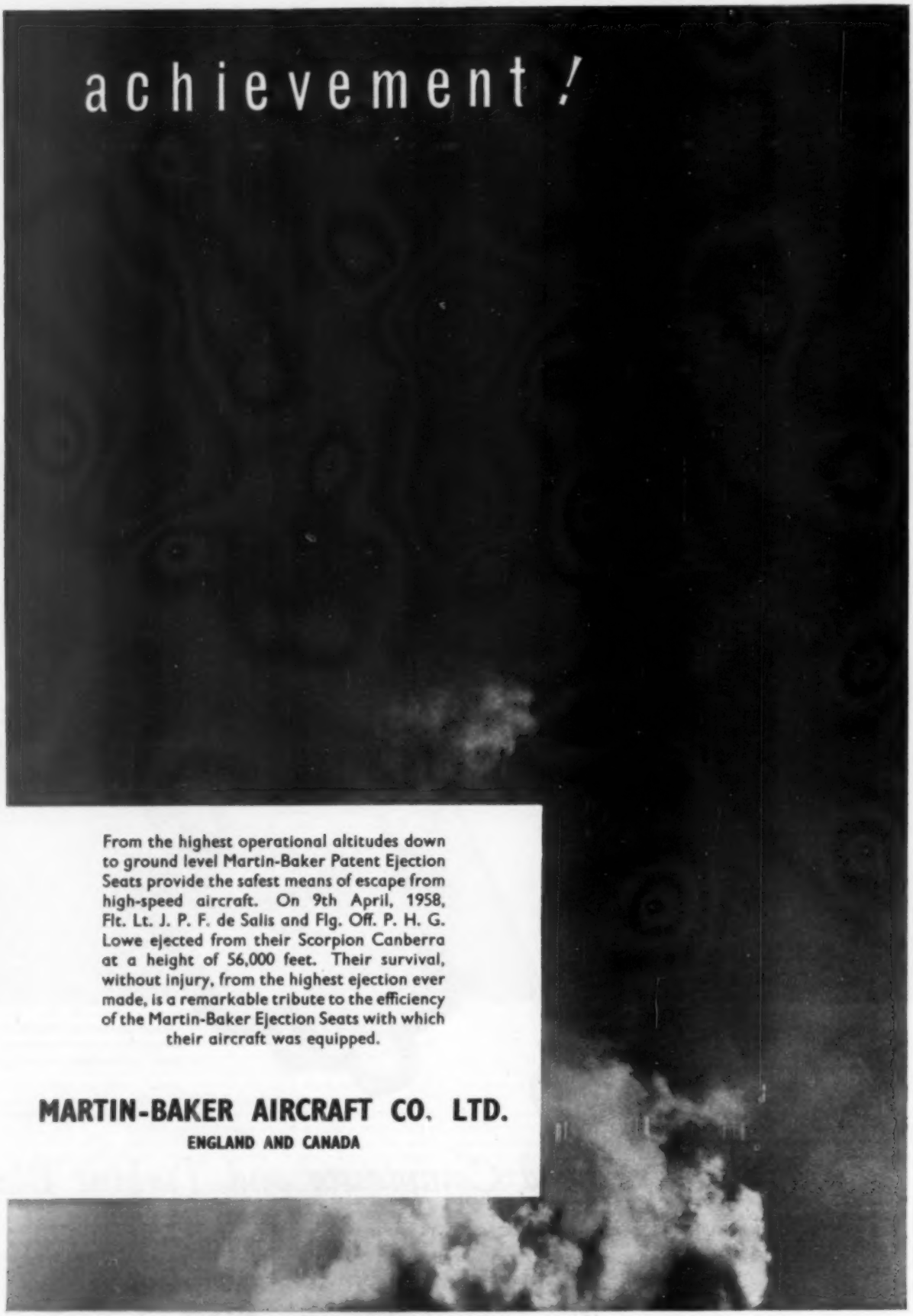

From the highest operational altitudes down to ground level Martin-Baker Patent Ejection Seats provide the safest means of escape from high-speed aircraft. On 9th April, 1958, Flt. Lt. J. P. F. de Salis and Flg. Off. P. H. G. Lowe ejected from their Scorpion Canberra at a height of 56,000 feet. Their survival, without injury, from the highest ejection ever made, is a remarkable tribute to the efficiency of the Martin-Baker Ejection Seats with which their aircraft was equipped.

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ENGLAND AND CANADA

Straight and Level

THE Lockheed victory in the airliner markets of Australia and New Zealand leaves me stupefied. There is no glossing over the hard facts: four British Commonwealth airlines—Qantas, T.A.A., Ansett-A.N.A. and T.E.A.L.—are to be re-equipped with American Electra turboprop airliners.

Lockheed have achieved this success in the face of: (1) The determined, on-the-spot competition (at managing-director level) of British manufacturers, (2) the Australian Government's economic predilection for British airliners, (3) the existence of long-established British aircraft and aero-engine factories in Australia and New Zealand, (4) the natural inclinations of Australians and New Zealanders towards the old country's products, (5) Australia's dollar shortage and (6) the long-established Qantas-B.O.A.C. partnership.

How did it happen?

The paramount reason was that the British manufacturers were defeated financially. They could not match the credit-terms, interest-rates and trade-in arrangements offered by Lockheed. The British aircraft industry says the Government must help it to offer better financial terms: the Government says that the industry must strengthen itself financially. Meanwhile, American firms sew up British Commonwealth markets.

But I am heartened by two things. The day after T.E.A.L. were told they were to have Electras the company's flag was flown upside down at half-mast above its office in Auckland. And in Vancouver on the same day Grant McConachie, president of Canadian Pacific Airlines, gave a tremendous boost to the Britannia and the Comet, adding: "I wonder why Australia does not follow's Canada's lead in supporting the British industry."

I am glad that such an eminent son of the Commonwealth, who (like his friend and rival Gordon McGregor of T.C.A.) has always championed British airliners, should have said that. It needed saying.

● I am not quite sure which are the highest structures in the world (measured above the local ground level, that is). There are some pretty tall buildings in New York City (Empire State's TV mast now tops 1,400ft, I believe), Moscow and, of course, Paris; and there are several radio masts of comparable height, of which I think the loftiest is that of the U.S.A.F. at Thule. Now I learn that the world will shortly have two more sky-scraping towers, and I am a little perturbed to find that each will be a gimmick and will be erected in a busy air-traffic zone.

Japan, it seems, has decided that the approaches to Haneda airport, Tokyo, will be improved by erecting, just about in line with a major instrument runway, a *replica of the Eiffel Tower*. For good measure, they propose to make it 100ft taller than the original, i.e. 1,084ft above the ground.

The other giant mast will be at the Hanover Fair, on the stand of Mannesmann, A.G., a famous German heavy-engineering firm. Utilizing the latest Mannesmann seamless steel tubular principles, the tower will be 1,148ft high, and will be ready for the German Industries Fair in 1959—provided someone doesn't fly into it beforehand.

● "Americans Celebrate in Britain" ran the news-agency caption to this alarming photograph, which depicts a U.S.A.F. fire-fighting show. By way of explanation, it continued:—

"Visitors see how about 8,000 Americans live in a camp [Alconbury, Huntingdonshire] which until June 1943 was an R.A.F. station, but which is now an all-American community."

I never fail to be impressed by the warmth of American hospitality.

● People who write publicity hand-outs and news stories should always try to forestall any possible misinterpretation. A recent release from the Royal Australian Navy on the passing of the Sea Fury from front-line service was picked up by one paper as meaning that these ten-year-old stalwarts would "eventually" be replaced by Sea Venoms. What is actually worrying the R.A.N. is what aeroplanes will replace their three-year-old Sea Venoms.

● I have just been treated to the following argument. "Because of the high speed [of a particular jet airliner] an engine overhaul life of 1,000 hours is equivalent to at least a 1,500-hour life on a piston engine."

Sorry, but it isn't necessarily so. Equivalent in what way? I agree that the jet may fly as many *miles* in 1,000 hours as a piston engine in 1,500 hours. But the airliner which it powers doesn't necessarily produce the same amount of ton-miles at the same cost.

● The recent F.A.I. conference in the U.S.A. must have been quite a party. On their way to Los Angeles, delegates stopped off at Fort Worth, Texas, where they were welcomed by a posse of mounted cowboys carrying banners and firing revolvers. Then, to quote the official report of the conference, "Unfortunately, and most extraordinarily, the weather was much too cool to permit the delegates to enjoy dinner in the open where there would have been an exhibition of horsemanship, revolver shooting and lassoo manipulation. However, the hosts at Fort Worth did their best by reproducing as many as possible of the demonstrations within the hotel."

That's the sort of hotel I like.

● The perishable properties of target-dates are familiar to everyone; but I doubt whether any targets have perished in quite the same way as those set by Boeing for the 707.

When American Airlines ordered thirty 707s in November 1955 they gave everyone a laugh by announcing that the first one would be put into service on June 15, 1959. (They wouldn't commit themselves to a particular time—after all, that would just be silly, three-and-a-half years in advance.)

Then, a year ago, they stated that the date had been revised: it was to be March 15, 1959.

A few weeks ago, in American Airlines' *Flagship News*, president C. R. Smith revised the date again. He announced that 707 jet services would be introduced between New York and Los Angeles—America's blue-riband route—"before the end of 1958."

The *latest* target date is November 1. So even if American Airlines do not get their 707s into service until half a year later, they will still be ahead of their original schedule.

The odd thing about all this is that I had to do quite a bit of research to dig out the facts, which neither Boeing nor American Airlines seems to think particularly remarkable.

● Flipping through the May 1958 issue of the A.R.B. Civil Aircraft Register I noticed a B.O.A.C. Britannia 102 with the recent registration G-APLL. This seemed odd: Britannia 102 production ceased a year ago, the fifteenth and last aircraft being registered G-ANBO.

Referring back, I found the explanation: dear old G-ANBG has apparently got so fed up with all the wisecracks that she has been re-registered.

No doubt the A.R.B. will be glad to revive NBG for anyone who feels it is appropriate to his aeroplane. In the meantime I suppose someone will try to make something out of the initials PLL.

ROGER BACON.

A span of 75ft 4in and an aspect ratio of 20.5:1 characterize the HDM.105 wing.
"Flight" photograph

Foretaste of the Caravan

HDM.105 HANDLING AND HDM.106 PROSPECTS

By C. M. LAMBERT

COLLABORATION between F. G. Miles, Ltd., and the French company Hurel-Dubois has already resulted in the remarkable HDM.105, basically a standard Miles Aerovan fitted with an Hurel-Dubois high-aspect-ratio wing. In *Flight* for June 18, 1954, we discussed in detail the *raison d'être* and the structure of the HD.32 transport, an aircraft which seemed to have an outstanding potential as a DC-3 replacement. But initial interest by Air France did not result for some reason in confirmation of a tentative order for a score of HD.32s for their services in North Africa. Six HD.34s are, however, being delivered to the Institut Géographique National for use in high-altitude photographic mapping.

Perhaps the indigenous Hurel-Dubois designs failed to establish themselves in airline and military service because the authorities were a little chary of committing themselves to a then radical wing. But the first Miles sortie into high-aspect-ratio aerodynamics does, one feels, stand a very much better chance of becoming accepted. What Miles are offering is, in fact, the HDM.106 Caravan, powered by two Lycoming supercharged GSO.480-Bs giving 340 h.p. each, and a maximum loaded weight of 8,000 lb. Miles' calculations of the performance of this machine have been examined in detail by independent designers; and the special capabilities of the aircraft for light transport, especially in tropical and high-altitude conditions, are shown in an accompanying table.

Though the HDM.106 Caravan promises to be an excellent light transport (NATO have expressed strong interest in it as a close-support transport for the Fiat G.91 light attack squadrons), a relatively small company like F. G. Miles, Ltd., are not able to undertake series production. Nevertheless, larger concerns, either in Britain or abroad, might well consider it a highly profitable venture in view of the large market which undoubtedly exists.

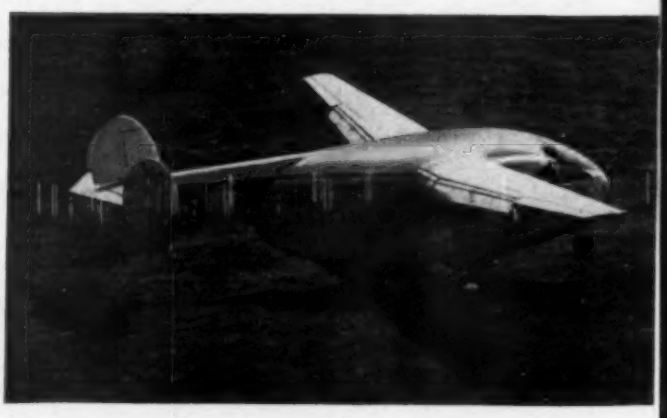
Briefly, the characteristics of the HDM-105 wing are as follows: span, 75ft 4in; area, 277 sq ft; aerofoil section, NACA 66-420, changing to 66-412 at the tips; aspect ratio, 20.5; t/c ratio, 20 per cent at the roots; dihedral, 3 deg; and wash-out, 5 deg. Retracted, the flaps occupy some 25 per cent of the wing area. The wing structure is based on a D-section torsion box formed by the single web spar and leading edge, with the skin (which is largely 20 s.w.g.) taking its share of the loads. A large proportion of the bending loads are taken by spanwise stringers. The high-aspect-ratio would produce an excessive structure-weight if the wing were not braced by struts; these, which impart a considerable stiffness to the whole lift system, are specially designed according to principles laid down by Hurel-Dubois to produce minimum of interference. The main undercarriage is supported on wide-chord vertical struts from the engine nacelles (incidentally, considerably increasing the track of the original Aerovan gear) and the strut bracing is completed by stub wings joining the undercarriage pylon to the lower fuselage. The strut and stub-wing assembly in fact assists aerodynamically by providing some 15 per cent of the total lift in the climbing condition.

In the HDM.105 two standard Aerovan flap actuators have been paired to operate the double-slotted, rearward-extending flaps; and lateral control is provided by a combination of ailerons and saw-toothed spoilers which extend above the wing as the neighbouring aileron moves up. Though the wing is stressed for a maximum gross weight of 6,000 lb, the gross weight of the aircraft as a whole has been kept at 5,800 lb. The standard Blackburn Cirrus Major powerplant of the Aerovan has been retained, with Fairey Reed fixed-pitch, metal propellers, and the maximum combined power available is 310 h.p.

I flew the HDM.105 at a weight of about 4,500 lb—that is, with myself and one passenger, about 20 gal of fuel and a standard Aerovan 9-seat passenger interior. Visibility from the balcony-like cockpit was, of course, superb; and the layout of instruments and controls was virtually that of a standard Aerovan. Flaps and elevator trim were both controlled by electric switches placed close together on the port console next to their dial indicators. Limiting speeds for various flap settings were rather low and elevator trim was extremely effective, so I took good care not to confuse the switches while airborne. Full blind-flying instruments and a certain amount of test instrumentation was fitted. Nosewheel steering from the rudder pedals could be engaged by pulling a lever or, conversely, wheel brakes could be applied with a hand lever and controlled differentially with the rudder pedals. Landings and take-offs could both be made with nosewheel steering engaged; with it free, differential brake could be applied to make tight turns on the ground.

I took off normally, using 20 deg of flap, and climbed straight up to 3,000ft to explore handling characteristics before coming back for some "circuits and bumps." I was primarily interested in the wing, flap and aileron characteristics, because these form the nucleus of the Caravan's design. I proceeded in three stages, namely from normal speed to the stall with the wing in turn clean, with 20 deg of flap and with the full 50 deg. At 3,000ft and 2,100 r.p.m. the speed stabilized at something over 90 m.p.h. The HDM.105 was pleasantly stable and, if it had not been that the left wing tended to drop, the aircraft would have flown hands-off indefinitely. Trim changes under large alterations in power were very small and both deceleration and acceleration were fairly slow. A good deal of rudder was needed to enter or leave turns and particularly when reversing from one direction to another. Because of the arrangement of the aileron cable runs in this particular aircraft the ailerons were rather heavy, but the rate of roll was remarkably good for such a long span.

After throttling right back, speed dropped progressively and a gentle, completely straight stall came after ample buffet warning at about 65 m.p.h. I.A.S. Ailerons and elevator remained fully



The double-slotted flaps, here seen extended for landing at Shoreham, lower the stalling speed from 65 m.p.h. to 30 m.p.h. I.A.S. At far right, the HDM.105 is turning over the coast near Beachy Head.
"Flight" photographs

effective right down into the stall—a most impressive and reassuring characteristic. General manœuvrability of the HDM.105 in both roll and pitch were very good indeed. The noise level was reasonably low and there was little air noise over the canopy.

Limiting speeds for various flap settings in the HDM.105 are fairly severe. A few degrees may be lowered at 91 m.p.h. but full flap is not allowed above 67 m.p.h., i.e., 2 m.p.h. above the clean stalling speed. The limiting speed for flaps, however, does vary progressively with the degree of flap extension and the margin between clean stalling speed and maximum speed for any given flap setting is not unnecessarily small.

With 20 deg of flap at 4,000ft I set 67 m.p.h. and climbed at between 120 and 180ft/min with 1,900 r.p.m. The change of trim on flap extension was negligible and effectiveness of elevator and ailerons appeared completely unchanged. Throttling back firmly with the stick free caused only a slow, deep dropping of the nose and, with the stick held, only a slight backward movement with a small pull force was required to hold the nose up. Despite an increase in area of the outboard fins and rudders over the standard Aerovan configuration, the directional control and stability of the HDM.105 deteriorated progressively as speed reduced. A good deal of rudder was required when entering and leaving turns, but this is stated to be an Aerovan rather than a Caravan characteristic. The vertical tail surfaces of the Caravan will, of course, be entirely new. I found I could make very steep turns with absolute confidence at 67 m.p.h. with 20 deg of flap. Apart from the decrease in speed, in fact, the handling of the aircraft seemed to have changed remarkably little. In view of the weight of the machine this seems quite an achievement.

I next extended full flap and had to apply a good deal of power to maintain height at 45 m.p.h. An initial nose-up trim change during this stage of flap extension was immediately cancelled by a couple of "blips" of the very powerful elevator trimmer. Rudder control was now very sloppy, but aileron and elevator again maintained excellent effectiveness. Stability remained good as well. Throttling back, I glided at 45 m.p.h. and noted a rate of descent of about 600ft/min. This could well be increased for short-field use; and airbrakes will, in fact, be fitted on the undercarriage pylons of the Caravan.

Being particularly interested in the manœuvrability of the HDM.105 at very low speeds, I next performed a series of steep turns at 50 m.p.h., starting with a high power setting and steadily decreasing power. With 45 deg of bank, I pulled $\frac{1}{2}$g and found pitching and aileron control excellent. Only in the steepest banks did I begin to feel uncomfortable; and, throttled right back in a descending steep turn, there was still plenty of lift and control. At 4,000ft, throttled back, the HDM.105 waffled and then stalled fairly decidedly at 40 m.p.h. I.A.S., initially dropping one wing about 20 deg. Aileron and elevator control still remained and recovery was immediate. With a considerable amount of power the aircraft stalled at least 10 m.p.h. slower—at 30 m.p.h. I.A.S.—with very little remaining rudder control but ample aileron and elevator. I then decided to return to Shoreham for some circuits and bumps and dived, throttled back, to about 110 m.p.h. There was no pronounced trim change with increase in speed and the controls did not "heavy up" unnecessarily.

In the circuit I slowed down and extended flaps and settled into a rather shallow glide approach with full flap at 50 m.p.h. I.A.S., noting a fairly nose-down attitude. Rudder control was poor and directional stability not brilliant, but otherwise the HDM.105 approached virtually hands-off. The flaps were very slow to extend and retract, and some time had accordingly to be allowed to avoid unexpected overshooting. The touch-down itself required a considerable round-out and was preceded by a lengthy float; but full, precise control made the landing very easy. Normal technique during both landing and take-off is to hold the nose well up.

Another take-off with 20 deg of flap from the bumpy Shoreham turf showed a tendency to buck over bumps, which seemed to be caused by the high mounting of engines and wings. A tidy unstick was a little difficult, but the HDM.105 generally jumped into the air very willingly and immediately began a steep climb. There was virtually no perceptible sink during flap retraction. I made my last take-off with the 40 deg of flap recommended by Miles. The result was quite spectacular. With the stick hard back the HDM.105 leapt into the air at a bare 30 m.p.h. and remained completely firmly airborne and climbing, without any tendency to flop back on to the ground. The ground run was exceedingly short. A particularly good point was that, during the whole flight, elevator trim remained very close to neutral, so that almost the full range would have been available to counteract c.g. variations.

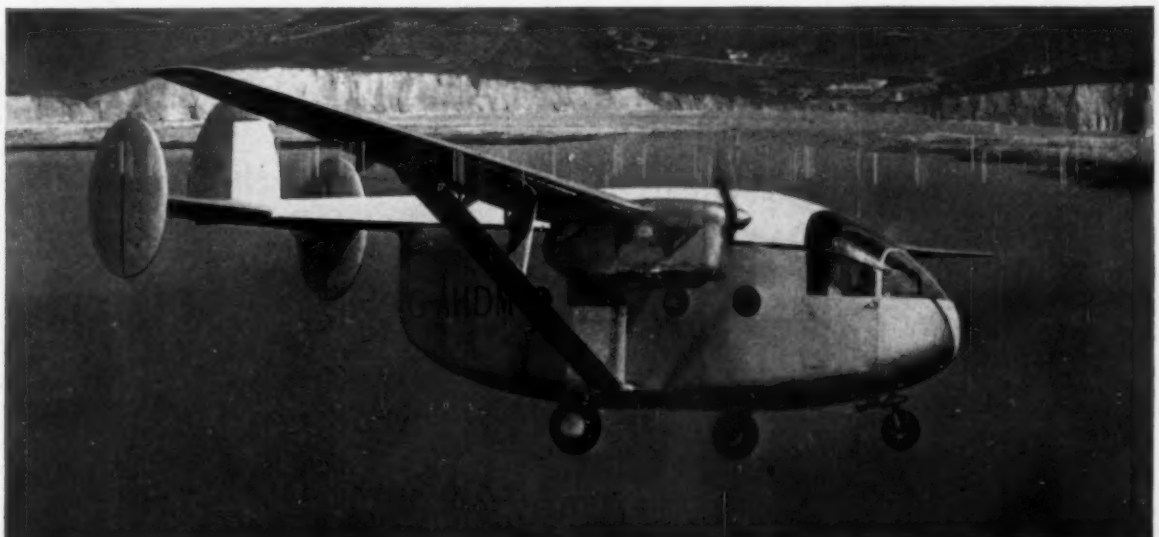
From this trial I would consider that the high-aspect-ratio wing offers quite remarkable potentialities for STOL applications. While giving a good cruising speed and excellent control in the clean condition, it also offers a remarkably wide margin between clean and "dirty" stalling speeds and excellent handling characteristics at speeds very close to the stall. A ratio of better than 2:1 between clean and dirty stalling I.A.S. is a valuable characteristic for any aircraft; and to combine this with full manœuvrability very close to the minimum stalling speed makes the aircraft an attractive short-field proposition. It is indeed remarkable to find a machine of relatively conventional layout which, at a flying weight of about 4,500 lb, will fly as slowly as a lightly loaded Gipsy Major-engined Gemini—and take off after a considerably shorter ground run.

Miles HDM.106 Caravan: Estimated Performance

	Two Lycoming GO-480	Two Lycoming GSO-480B
Take-off gross weight	8,000 lb	8,000 lb
Take-off power at s.l.	2×290 h.p.	2×340 h.p.
Max. speed at s.l.	155 m.p.h.	163.5 m.p.h.
Cruising speed at 5,000ft at 50 per cent power	120 m.p.h.	129 m.p.h.
Specific range at 5,000ft at 50 per cent power	6.60 s.a.m.p.g.	5.45 s.a.m.p.g.
V_s, flaps up, power off	86 m.p.h.	86 m.p.h.
V_s, flaps at 20 deg	73 m.p.h.	73 m.p.h.
V_s, flaps at 40 deg	64 m.p.h.	64 m.p.h.
Rate of climb at s.l.	1,027ft/min	1,279ft/min
Single-engined rate of climb at s.l.	190ft/min	309ft/min
Service ceiling (100ft/min)	Approx. 18,000ft	Approx. 25,000ft
Take-off to 50ft		
concrete	536 yd	444 yd
grass	572 yd	479 yd
Minimum distance to unstick		
concrete	266 yd	221 yd
grass	302 yd	256 yd
Take-off distance with 10 per cent overload		
concrete	668 yd	559 yd
grass	721 yd	596 yd
Landing from 50ft		
concrete	437 yd	437 yd
grass	480 yd	480 yd
Minimum ground run		
concrete	93 yd	93 yd
grass	126 yd	126 yd

HDM.106 Tropical and Altitude Performance with GSO-480B Engines at ICAN +30 deg

	Sea Level	4,000ft
Take-off to 50ft	506 yd	542 yd
Rate of climb		
Two engines	1,142ft/min	1,110ft/min
One engine	200ft/min	190ft/min
Service ceiling		
Two engines	19,000ft	19,000ft
One engine	10,000ft	10,000ft



The S-62 shows off its flying-boat hull. Turbine-powered, it carries 700 lb more useful load than the S-55 and cruises 20 m.p.h. faster.

S-62

Sikorsky's Amphibious Helicopter

A NEW turbine-powered 8-12 passenger helicopter, the S-62, has just made its début at Sikorsky's Stratford, Connecticut, plant. It is the world's first amphibious helicopter to embody a flying-boat hull. In the past, helicopters intended for water operations have been fitted—at considerable penalties in weight and drag—with pontoons: likewise, single-engined helicopters intended for passenger operations over built-up areas have—in the absence of a second engine—been required to fit pontoons for emergency landings on water. In this rôle pontoons represent, in effect, a second engine: the S-62, though single-engined (G.E. T58 or Lycoming T53), was designed from the outset as a helicopter capable of water operations with the minimum built-in penalties of weight and drag.

The vee-bottom of the fuselage is designed to cushion impacts when landing on water and to throw spray outwards and down. For land operation, wheels are mounted under two floats. Located forward and well away from the fuselage, the floats resist pitching and rolling during landings or while at rest on the water.

Powerplant of the first model is General Electric's 900 s.h.p. T58 (the turbine which is being licence-built in the U.K. by de Havilland, who have designated it the Gnome). Alternative powerplant is Lycoming's T53. Delivery of the S-62 could be made in 1959, "contingent," say Sikorsky, "on the availability of engines at an acceptable price and with proven dependability."

The S-62's relationship to the S-55 is important. Sikorsky's claim is as follows: "The S-62 is the first helicopter in history that will fly from the start with proven mechanical components having extended overhaul periods of four to five times longer than normally expected of new components. This has been accomplished by blending a new airframe and a modern gas turbine powerplant with the mechanical components of the time-tested Sikorsky S-55 helicopter."

Actual S-55 components incorporated in the S-62 include all main and tail rotor heads and blades; main, intermediate and tail gearboxes; shafting, tail rotor pylons, and major portions of flight control and hydraulic systems. This makes possible Sikorsky's offer to S-55 operators to turn in their machines for "retrofits," which comprise the installation of all these S-55 components in a new S-62 airframe, together with the new T58 or T53 turbine engine.

Various items of special equipment can be installed in the S-62. This equipment includes a 600-lb-capacity rescue hoist, an external cargo sling capable of carrying 3,000 lb, internal ferry tanks, an adaptation of the S-55 winterization kit tested at minus 65 deg, pilot and co-pilot oxygen provisions, and a towing attachment to provide 4,000 lb of pull for such work as removing damaged aircraft from runways or assisting ground equipment which may have become bogged or disabled. The towing attachment is intended for water rescue work, where disabled boats of many sizes have to be towed to safety, and in amphibious military operations when landing craft break down well out from shore.

In addition, the all-metal, interchangeable blades for the main rotor—as first introduced by Sikorsky—will be standard equipment on the new aircraft.

S-62 Preliminary Technical Data

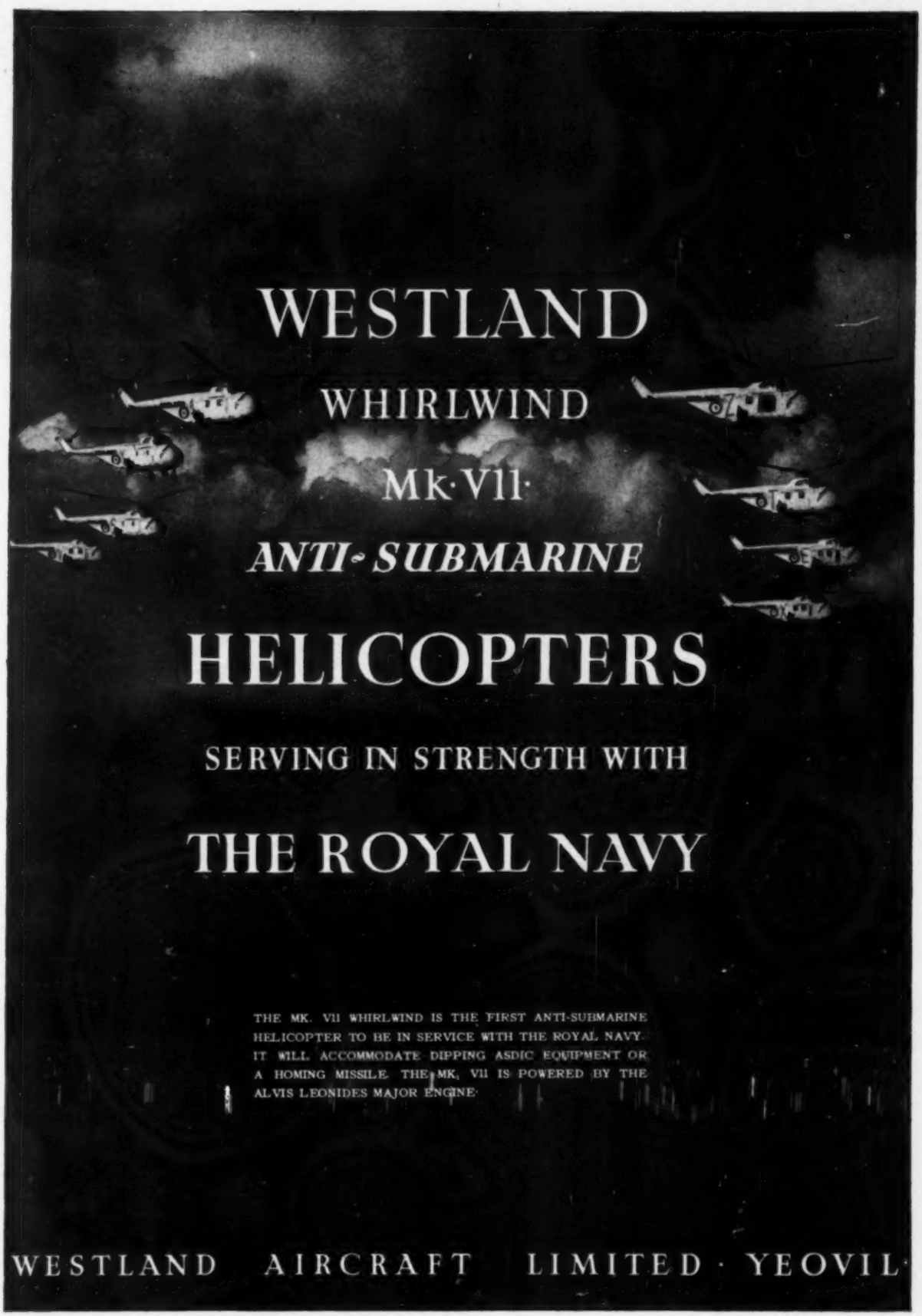
Amphibious Version Powered by G.E. T58-GE-6

Performance: High speed at sea level, 117 m.p.h.; cruising speed, 98 m.p.h.; maximum rate of climb at sea level, 1,160ft-min; hovering ceiling without ground effect, 8,000ft; service ceiling, 15,700ft; fuel consumption (cruising), 52.5 Imp. gal/hr; range (with 152 gal fuel plus ten per cent reserve at cruising speed), 230 st.m.

Weights: Gross weight, 7,500 lb; useful load, 2,950 lb; weight empty, with standard equipment, 4,550 lb.

Dimensions: Fuselage length, 44ft 7in; fuselage width, 5ft 10in; height overall, 14ft 2in; main rotor diameter (blade tip circle), 53ft; tail rotor diameter (blade tip circle), 8ft 9in; main landing gear tread, 11ft; passenger cabin length, 14ft; passenger cabin width, 5ft 4in; passenger cabin depth, 6ft; fuel capacity, 152 Imp. gal.

Lightness of the T58 turbine permits it to be installed on top of the fuselage, well clear of spray. Right, the S-62 lands on the Housatonic River near Sikorsky's plant. Accommodation is for eight passengers or 12 troops.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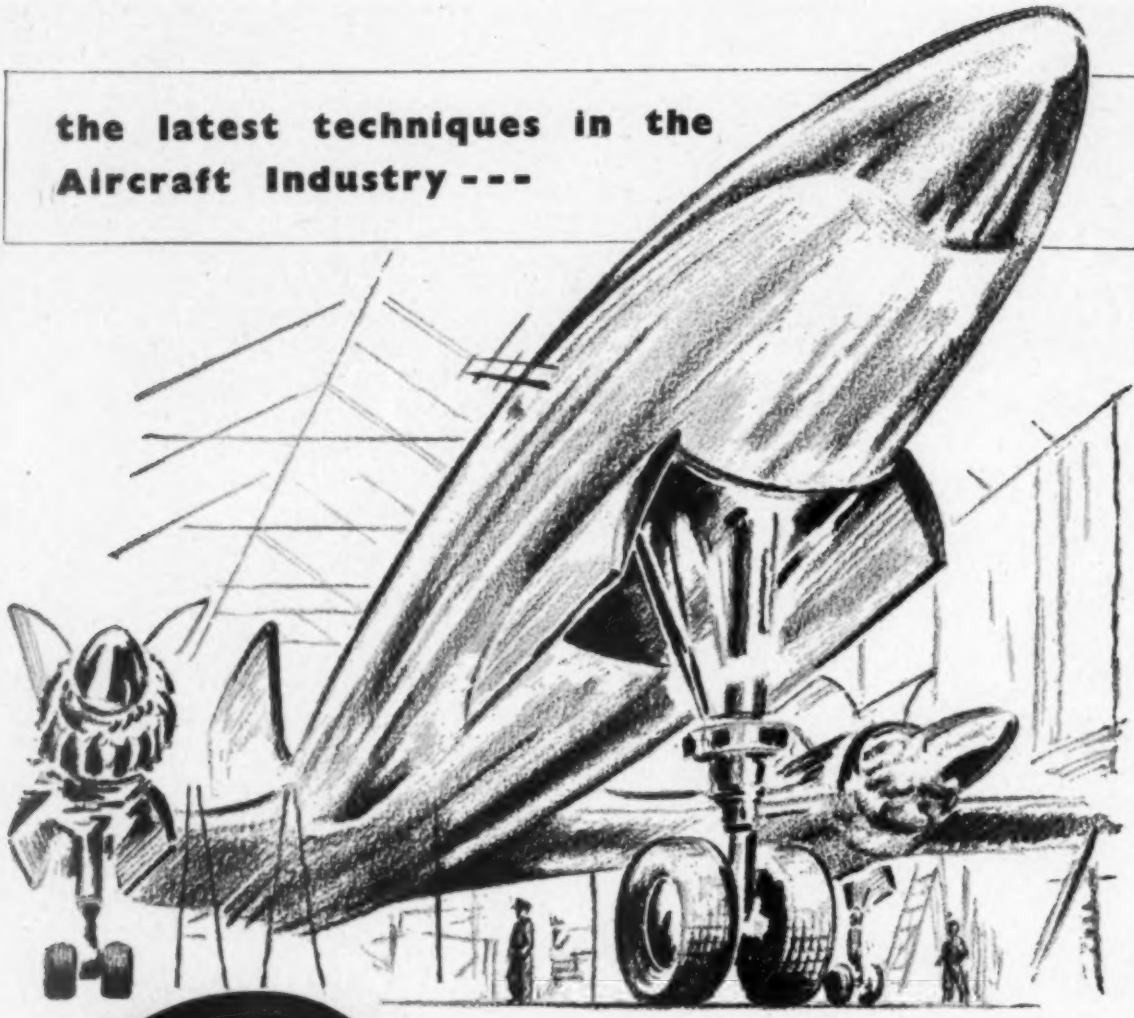

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Mr. Melvin Gerstein, assistant chief, propulsion chemistry division of Lewis Flight Propulsion Laboratory, N.A.C.A., presented a *Review of Some Recent Combustion Experiments*. He described a number of basic combustion experiments to show the status of knowledge of the chemical processes in flames. Reaction rates and orders derived from a number of flame properties are quite similar, suggesting that similar chemical reactions are involved. Certain inconsistencies exist, however, which may indicate changes in mechanism with alterations in fuel/oxidant ratio, particularly for hydrocarbon flames. A large part of the reaction in a hydrocarbon/air flame does not appear to involve the original fuel molecule, which breaks down early in the flame reaction zone. Unfortunately, many flame-investigations have been made under widely different experimental conditions, so that quantitative comparisons are difficult to make. It would be desirable to study some reasonably simple reaction to determine whether a consistent reaction order and activation energy can be derived from flame velocity, quenching distance, flashback-velocity gradient, flame structure and other properties. The reaction constants derived from these properties could then be compared quantitatively with the known reaction kinetics.

Rôle des Rechèrches Fondamentales dans l'Etude des Foyers d'Aviation by **M. Claude Foure** of ONERA had a remarkable bibliography of 111 items. He pointed out that the study of aviation combustion chambers calls for research into phenomena already of recognized importance; injection, vaporization and combustion of clouds, flame stabilization and propagation, spontaneous ignition of combustible mixtures, homogeneous reactions, and internal aerodynamics. The general method of similarity helps in the analysis of the effects of altitude and scale where aero-

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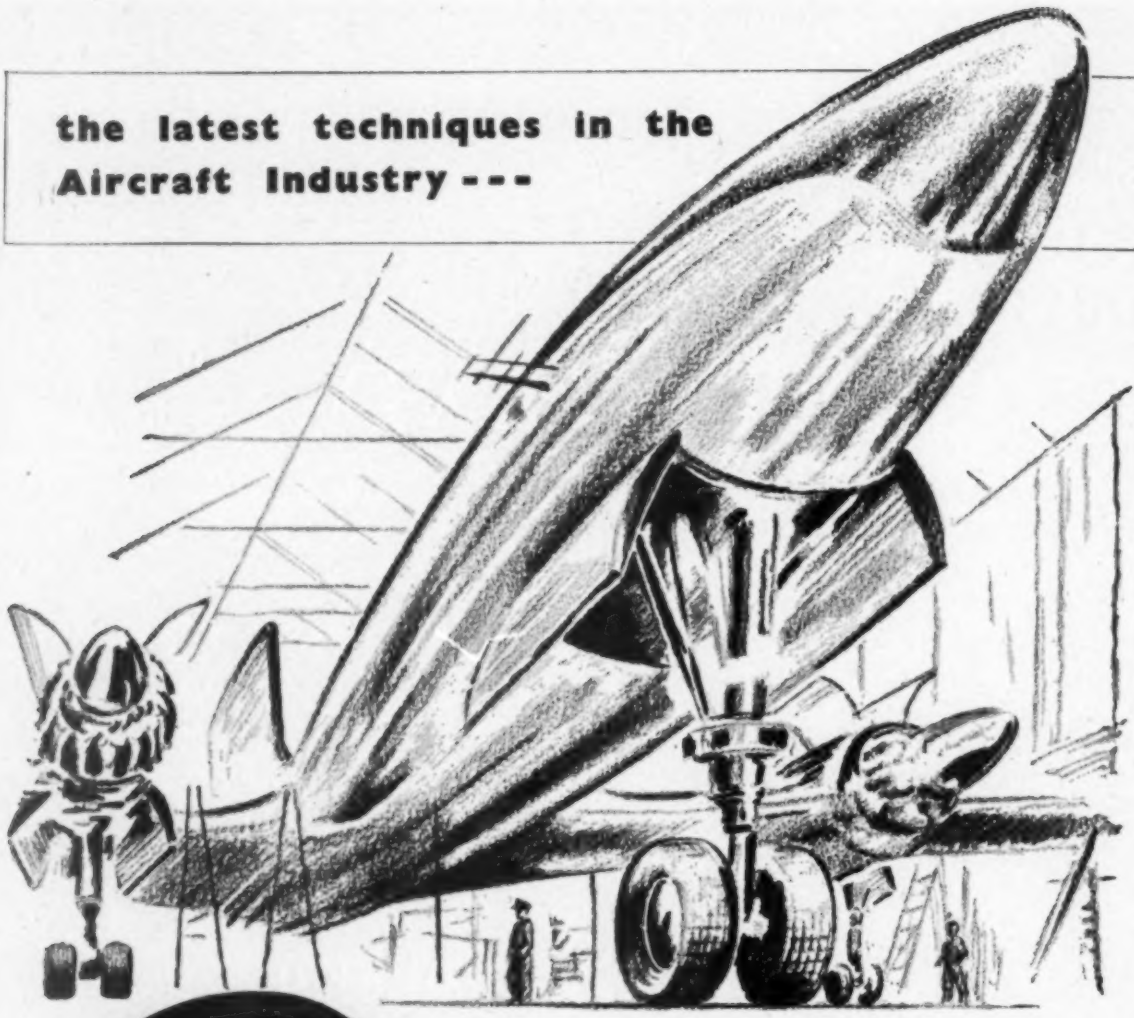

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Four papers were presented in Group IV, the Combustion Session, the one which perpetuated the original purposes of the Panel, starting with *Recent Progress in Flame Theory* by **Mr. D. B. Spalding** of Imperial College. Until 1953, when Avery, Longwell, Bragg and van Heerden published separately their three basic ideas, the reasons for the extinction of steady-flow flames at high velocity or low pressure were not clear. It is only possible to study flame phenomena by simplifying the whole flame complex into separate groups of processes—fluid mechanics, heat and mass transfer, chemical reaction—and to treat the gas state and chemical features locally. Even so, combustion theory is too much for busy men to study and so Mr. Spalding offered seven "U.H.T.s"—"useful half-truths": *The aerodynamic half-truth:* In a given steady-flow combustion chamber, the streamline pattern depends only on overall fuel-air ratio (OFAR); *the mixing half-truth:* The local fuel/air ratio (LFAR) at any point in a combustion chamber of given shape depends only on the overall fuel/air ratio, and the position of the point; *the thermodynamic half-truth:* In a given two-stream flow, the state of the local gas mixture is completely specified by the local fuel/air ratio and the local reactedness, τ, the relation between the properties being that for adiabatic steady-flow mixing; the *chemical half-truth:* The local volumetric reaction rate in a flame depends only on the local fuel/air ratio and the local reactedness; *the two-stream half-truth:* The state of a two-stream steady flame in a given chamber depends only on its dimensionless loading, L_2, and the overall fuel/air ratio; *the one-stream half-truth:* The state of a one-stream steady flame in a given chamber depends only on its dimensionless loading, L_1; *The superposition half-truth:* The reactedness at any point in a steady flame is equal to the sum of the increments of reactedness which would be caused at that point by the volumetric reaction rates prevailing at each increment of flame volume, if that incremental volume alone were reacting.

These seven U.H.T.s were explained and elaborated, after which six examples were discussed to make the case that today's problems are no longer restricted to laminar flame propagation and the homogeneous reaction zone. There is hope now that theory can be used to predict the results of a change in chamber geometry and that the chemist can use flame theory much more. There are three outstanding tasks: for the engineer to study models of engine-like geometry to see if separate fuel and air induction is better than pre-mixing; for the aerodynamicist to study turbulent flows involving simultaneous jet-mixing, recirculation and chemical reaction; and for the chemist to devise experimental flame arrangements that are amenable to theoretical analysis, are easily set up, controlled and measured, and give widely differing results according to the reaction-kinetic scheme involved.

Mr. Melvin Gerstein, assistant chief, propulsion chemistry division of Lewis Flight Propulsion Laboratory, N.A.C.A., presented a *Review of Some Recent Combustion Experiments*. He described a number of basic combustion experiments to show the status of knowledge of the chemical processes in flames. Reaction rates and orders derived from a number of flame properties are quite similar, suggesting that similar chemical reactions are involved. Certain inconsistencies exist, however, which may indicate changes in mechanism with alterations in fuel/oxidant ratio, particularly for hydrocarbon flames. A large part of the reaction in a hydrocarbon/air flame does not appear to involve the original fuel molecule, which breaks down early in the flame reaction zone. Unfortunately, many flame-investigations have been made under widely different experimental conditions, so that quantitative comparisons are difficult to make. It would be desirable to study some reasonably simple reaction to determine whether a consistent reaction order and activation energy can be derived from flame velocity, quenching distance, flashback-velocity gradient, flame structure and other properties. The reaction constants derived from these properties could then be compared quantitatively with the known reaction kinetics.

Rôle des Rechèrches Fondamentales dans l'Etude des Foyers d'Aviation by **M. Claude Foure** of ONERA had a remarkable bibliography of 111 items. He pointed out that the study of aviation combustion chambers calls for research into phenomena already of recognized importance; injection, vaporization and combustion of clouds, flame stabilization and propagation, spontaneous ignition of combustible mixtures, homogeneous reactions, and internal aerodynamics. The general method of similarity helps in the analysis of the effects of altitude and scale where aero-

COMBUSTION AND PROPULSION . . .

thermodynamics is the basis of the establishment of performance criteria and overall combustion efficiency. Hydraulic models can be used to study flow and facilitate its visualization. The author felt that his studies pointed to the importance of closer contact between research workers and those concerned with the design and use of actual combustion chambers.

Mr. R. Schulz and **Mr. L. Green Jr.** of Aerojet-General and **Mr. S. S. Penner** of Guggenheim Jet Propulsion Laboratory of California Institute of Technology read a paper as massive as its title: *Studies of the Decomposition Mechanism, Erosive Burning, Sonance and Resonance for Solid Composite Propellants.* The specialized review of recent experimental and theoretical work on these related subjects defies condensation and the interested reader is referred to the collected papers due for publication in the autumn. [*Selected Combustion and Propulsion Problems 1958*, AGARD, Palais de Chaillot, Paris XVIe, France.]

The fifth and final Session, on Aerophysical Chemistry, was scientific and specialized and contained the only German contribution. It was opened by **Mr. Ronald E. Meverott,** Lockheed Missile Systems Division, with *Radiation Heat Transfer to Hypersonic Vehicles.* He surveyed what is known about the emission characteristics of air at temperatures and densities of interest for radiation heating in hypersonic flight. He illustrated the problem by considering two examples: a locally hemispherical ballistic missile nose re-entering the atmosphere, and a sphere used as a circumlunar carrier under extreme re-entry conditions. These examples were followed by a survey of the existing theory of the emissivity of air and an analysis of recent experimental data. The progress made in the determination of the absorption and emission coefficients of air in the past two years have been encouraging, and preliminary values of the most important f-numbers for several molecular transitions are now known. Sources are now available for the study of widths of molecular lines and in the next year or so these line-widths will probably be well determined. When this has been done reliable tables will be derived for the radiation heat-transfer problem.

High Temperature Shockwaves were discussed by **Mr. Otto Laporte** of the University of Michigan. The phenomena of modern high-speed aerodynamics with the concomitant high temperatures make it necessary for the aerodynamicist to become familiar with such quantum phenomena as molecular vibration, dissociation and ionization. Of the few flow patterns which can be discussed quantitatively, the normal shock was chosen for a detailed study because by means of it high temperatures can be produced in the laboratory with relative ease. The methods which have to be employed are gradually being developed, and it will therefore be possible for the investigator to calculate other flows, such as rarefactions or oblique shocks. The discussion of strong waves was divided into three sections: monatomic gases, whether noble gases or metallic vapors; shocks in molecular, especially diatomic, gases; and non-equilibrium phenomena and experimental results.

Prof. Lester Lees of the Guggenheim Aeronautical Laboratory, California Institute of Technology, gave a detailed and mathematical survey of *Convective Heat Transfer with Mass Addition and Chemical Reactions.* This was an account of progress and problems in convective heat transfer with chemical reactions, including reactions involving the vaporizing or sublimating of surface material. By generalizing the Shvab-Zeldovich formulation for low-speed, constant-pressure flames it is possible to arrive at general conclusions about laminar heat transfer that are independent of the "model" of chemical reaction, of the magnitude of the reaction rates, and of any statements about the momentum equation, provided only that the Lewis-Semenov number is unity. Reaction rates play a secondary role in determining the mass fractions of the chemical species at the surface and the distribution of transport properties across the flow. The heat released in chemical reactions appears as an additional "enthalpy potential," but when these reactions involve surface material this potential is partially counterbalanced by the heat of sublimation (or vaporization). Far from being "catastrophic," combustion of surface material is actually advantageous if the heat of sublimation is comparable with the heat of reaction in the gas phase. Also, the heat transfer rate is reduced in this case by the well-known "blocking effect" of mass addition at the surface.

Since the Lewis-Semenov number for all real gas mixtures is generally different from unity it is helpful to have some estimates of the influence of this parameter on laminar heat transfer. As an illustration, such estimates are worked out for the limiting case of "very slow" reactions in the gas phase, when all reactions occur (if at all) at a catalytic surface.

A number of interesting problems require investigation, including: estimation of transport properties of high-temperature reacting gas mixtures containing a light gas component, such as hydrogen; radiation from hot gases containing products of reaction; and interaction between changes in body shape brought about by sublimation (or vaporization), and heat transfer rates and aerodynamic properties, including the question of the "stability" of this interaction. In a somewhat different category is the old, continuing requirement for detailed experimental studies of the transport mechanism in turbulent shear flow over a wide range of Prandtl and Schmidt numbers. J. H. S.

On Magneto-Fluid-Dynamics, the final paper, by **Arnulf Schlueter** of Göttingen, covered a physical subject, as yet unfamiliar in the aeronautical context. Magneto-fluid-dynamics, alias magneto-hydrodynamics, or hydromagnetics, concerns the movement of electrically charged (ionized) fluids in the presence of electromagnetic fields. Electrically charged liquids or gases are very common in engineering as well as in nature. They range from liquid metals in atomic reactors to combustion gases, and the rarefied air within the ionosphere of our globe. All these ionized states are subject to the laws of magneto-hydrodynamics. More recently, plasma flows of a high state of ionization accompanied by very high temperatures have become of great importance not only for research, but also for the realization of thermonuclear possibilities, e.g. the ZETA reactor. The "pinch effect" of electromagnetic fields affecting such plasma flows, permits the containment of gases at extremely high temperatures without walls.

A theoretical approach was presented for dealing with the behaviour of fluids with charged particles within electro-magnetic fields on a physically strict basis. So long as the fluid is practically incompressible—e.g., if it is a molten metal—the theoretical treatment is relatively straightforward. The continuity equation is hydromagnetically unaffected by the presence of electromagnetic fields and the equation of state holds with sufficient accuracy. Thermodynamically, only minor adjustment is needed if the density is sufficiently high. The standard form of Ohm's Law applies for both the electric current and charges. The Hall Effect (a secondary electric field perpendicular to current and magnetic field) and thermo-electric effects are negligibly small. The electrostatic energy component can always be neglected for plasma flows.

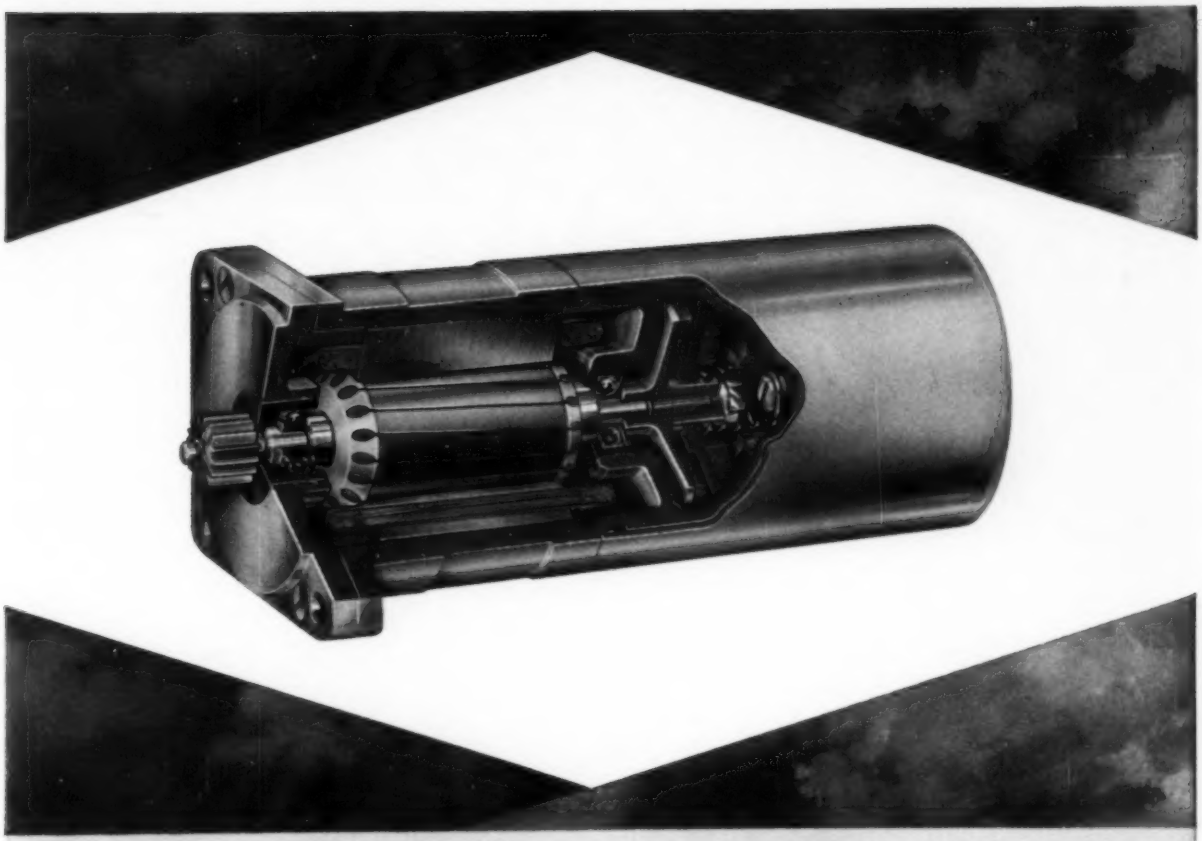
Nevertheless, the theoretical approach becomes rather involved when effects of compressibility can no longer be disregarded, as in gaseous plasma flows of high ionization and high density, i.e., in magneto-gasdynamics. The equation of state is then basically modified and a more generalized Ohm's Law has to be established. A new theoretical treatment of this domain of magneto-gasdynamics can be based on the "two-fluid" model for the completely ionized state and on a three-fluid, or "plural-fluid," model for partially ionized plasmas or mixtures.

In the "two-fluid" model, the plasma is treated as consisting of two intermingling, interpenetrating fluid constituents, one formed by the positively charged ions, and one by the negatively charged electrons. Each of these flow constituents is treated as an ordinary fluid. This leads to an equation of motion for each flow constituent, with a propulsive force derived from the interaction between the electric field and charge density, and from the action of the magnetic field on the current in consequence of the motion of the constituent. The fluid constituents, of course, interact with each other. The friction coefficient is independent of the electric field and only slightly affected by the magnetic field. The existence of plasma oscillations leads to a simplification of the theory, and the laws of the kinetic gas theory can be applied with success.

The result of this summary, but strict, treatment is that in a strong magnetic field the particle motion along the lines of force is unconnected with the spiralling motion around the lines of forces. The spiralling-motion particle energy is somehow linked to the compression across the lines of force—the "pinch effect." A. R. W.

FORTHCOMING EVENTS

June 6. Helicopter Association: a.g.m. and lecture: "Turbine Helicopters," by D. L. Hollis Williams.
June 7-8. Aéro Club de France: Normandy Rally.
June 7. Helicopter Association: Garden Party and Rally, Dunsborough Park, Ripley, Surrey.
June 8. Royal Dutch Aero Club: Balloon Trophy Competition, Rotterdam.
June 8. Wolverhampton Aero Club: Members' Competition Day.
June 9. Opening of Gatwick Airport by H.M. The Queen.
June 14. Plymouth Aero Club: Air Display.
June 14-15. Popular Flying Association: Rally, Rhoose, Cardiff.
June 15-29. World Gliding Championships, Poland.
June 18. Kronfeld Club: "The Early Days," by F. N. Slingsby.
June 19-28. OSTIV: Seventh Congress, Osieczna, Poland.
June 20-23. Lerida Aero Club: International Tour of Pyrenees.
June 20-23. Palermo Aero Club: Tour of Sicily.
June 21. R.N. Air Station Ford: At Home.
June 22. R.Ae.S.: Garden Party, White Waltham.
June 25. Kronfeld Club: Polish film, "The First Start."
June 27-29. Royal Dutch Aero Club: International Rally.
June 28. Exeter Aero Club: Flying Display, Exeter Airport.
June 28. R.A.F.A. (Cheltenham and Gloucester Branches): Air Display, Staverton Airport.
June 28. R.N. Air Station Abbotsinch: At Home.
June 28-29. Flers Aero Club: Normandy Rally.
June 28-30. R.Ae.C.: Private Air Rally, Le Boulc.
Sept. 1-7. S.B.A.C. Display and Exhibition, Farnborough.



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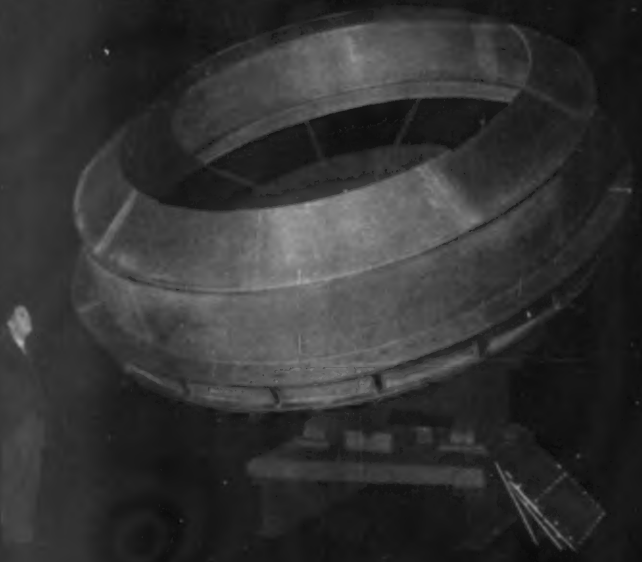

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Left, the Mayor of Gloucester, Councillor V. T. G. Bennett, received his first flight in a Cheltenham Aero Club Messenger at the club's At Home at Staverton on May 24. His pilot was C.F.I. Les Titmus. Right, the Aviamilano Nibbio four-seater, referred to in a news item below.

CLUB AND GLIDING NEWS

THE Whitsun weekend rally at Lasham Gliding Centre brought the three new Elliotts sailplanes—the Olympia 415 and the first two 419s—into public view for the first time. Saturday's wind was too strong for any contest flying, but on Sunday, May 25, distance along a line through Camphill was the set task. The day's best flights were by Anthony Deane-Drummond (Olympia 419, 190 miles to Yeadon), David Ince (Olympia 419, 130 miles) and Aylett Moore (T.42, 98 miles). On Monday, distance around a 50 km triangular course with turning-points at Worthy Down and Whitchurch was specified: three laps of this triangle were completed by Nicholas Goodhart (Skylark 3), Col. Deane-Drummond (Olympia 419), Anthony Goodhart (Olympia 415), David Ince (Olympia 419) and Aylett Moore (T.42). Final results of the rally gave first place to Col. Deane-Drummond; a special prize went to George Burton for the best flight in a 15-metre machine on the Sunday—126 miles (total) or about 80 miles (projected) in an Olympia; and the Monday prize was divided between the five pilots who each completed three circuits.

ON Tuesday, May 27, a flight to 11,600ft was made from Lasham by Miss Brenda Horsfield in a Skylark 2. This is the first Gold C height to be achieved by a British woman pilot. Two further notable flights from Lasham took place on Wednesday, May 28. John Williamson and Mrs. Ann Welch flew 101 miles to Westbury in a T.42 to beat the U.K. two-seater out-and-return record. In a Skylark 3, Mrs. Anne Burns set up new women's U.K. and British national out-and-return records by flying 97 miles to Kidlington and back.

WINNING club in the R.A.F. Gliding and Soaring Association championships at South Cerney, which ended on May 26, was the Wessex Club, Andover, which achieved top marks in both high-performance and low-performance categories of the contest. Sgt. A. Gough (Skylark 3), a member of the Wessex club, was placed first in the high-performance class on three occasions: for a 133-mile flight on May 20 (goal task to Hawkinge); the 346-mile record flight to Heerlen, Holland, on May 21 (free distance); and 126 miles on May 25 (goal task to Marham). The high-performance winner on May 26 was W/C. N. W. Kearon (Olympia), also of the Wessex club, who achieved 32 miles of a 47-mile triangle. Daily winners of the low-performance class (for strutted aircraft) were F/L. D. Spottiswood (Eon Baby), East Anglia Club; F/L. G. Rondel (Gull 1), Fenlands Club; Cpl. W. Langley (Kite 1), Wessex Club; and S/L. J. Croshaw (Sedbergh), Moonrakers Club. The final club positions were as follows: High-performance class: 1, Wessex Club, 270.4 points; 2, Moonrakers Club, Upavon, 234; 3, Windrushers Club, Bicester, 139.9. Low-performance class: 1, Wessex, 168.7; 2, Moonrakers, 146.1; 3, Fenlands, Marham, 127.8. Individual champion pilots were Sgt. Gough and S/L. T. Ware of the Fenlands Club respectively.

Speaking at a final championship party at South Cerney, A. Cdre. G. J. C. Paul (who founded the R.A.F.G.S.A. in 1949) announced that the Association was shortly to acquire a number of new sailplanes. Notable flights during the South Cerney meeting had included a 69 m.p.h. flight to Dishforth by F/L. K. Fitzroy in an Olympia; and climbs to 14,000ft on two occasions by F/L. Roger Mann (Gull 4) during the goal race to Marham.

AT Sandown, Isle of Wight, on Whit Monday, May 26, the winner of the Tiger Club race for the Basil Monk Trophy was C. Nepean Bishop, flying his namesake the Rollason Bishop conversion of the Tiger Moth. During the air display which accompanied the racing, the Rollason-built Turbulent G-APBZ was severely damaged and its pilot, Lt. Cdr. J. F. S. Overbury, was seriously injured when the machine crashed in the aerodrome car park. Among the other aircraft demonstrated were Turbulent G-APIZ, a Jackaroo, and the Bishop in its aerobatic rôle. Gliding and parachuting were also included on the programme.

THE Italian aircraft company Aviamilano have formed an *écurie* to take part in international sporting events with the four-seater Nibbio and two-seater Falco which they are now producing. The leading pilots will be Ing. Mario Vietri and Vico Rosaspina, both well-known sporting pilots in Italy and France. Though the concept of the company-sponsored *écurie*, familiar in motor racing, might indicate a concerted competitive effort on the part of the company, Aviamilano claim that the sole object of their *écurie* is simply to display and demonstrate their aircraft. The first event in which they will take part will be the Grand Prix de France, which is to be flown between La Baule and Deauville between July 15 and 18.

A NEW version of the Piper Comanche, known as the Comanche 250, is now in production at the Lock Haven plant of Piper Aircraft Corp. As distinct from the 180 h.p. engine of the earlier model, the new machine is powered by a 250 h.p. direct-drive Lycoming O-540 engine. Gross weight is increased by 250 lb to 2,800 lb; cruising speed at 8,000ft is stated to be more than 180 m.p.h.; and cruising range at 75 per cent power is 740 miles (4.3 hours), or 1,100 miles (7.5 hours) at economical cruising power. The first Comanche 250 was delivered during last month to a customer in Alaska.

The first Comanche to fly the Atlantic for delivery in Europe was a 180 h.p. machine, N5089P, which arrived at Lisbon at the end of April. Following its appearance on display at the Brussels World Fair and at the Hanover Air Show, the machine was delivered to a German customer. The Comanche was flown from Miami, Florida, to Lisbon *via* Bermuda and the Azores.

Similar designs, contrasting tails: Mooney Mk. 20 (left) and Piper Comanche (first of its type in Europe) seen at the recent Hanover air show. Adaptation of the Mooney was considered by Piper during the development of the Comanche, a new version of which is reported above.

"Flight" photographs

CIVIL AVIATION

The first service into Gatwick Airport was operated on May 30 by this Transair Viscount, seen disembarking passengers after a trooping flight from Malta. (Feature article on London's new airport: pages 770-774.)

THE DC-8 FLIES

AN historic event for the Douglas Aircraft Company, and for the world's air transport industry, took place at Long Beach California last Friday, May 30. The first DC-8 jet transport made a successful 2 hr 10 min maiden flight on that day.

The text of the Douglas statement which followed read:—

"Before a crowd of 50,000 spectators, the first Douglas DC-8 made its maiden flight at ten o'clock this morning. After a notably steady take-off the giant jetliner climbed to 5,000ft before turning northward over the Pacific Ocean parallel to the shoreline.

"Following pre-flight test plans, the landing gear, flaps and controls were checked before the plane soared higher into the California sky. Two hours and ten minutes later the 150ft long DC-8 made a perfect landing at Edwards Air Force Base.

"Chief of the three Douglas test pilots aboard, A. G. Heimerdinger, commented afterwards: 'Of all the DC-models I have flown, the DC-8 is the greatest of them all.'

"Seventeen airlines had invested more than $700,000,000 in the purchase of 138 DC-8s before the first one flew. The first nine of the 600 m.p.h. DC-8s to be produced will undergo the most extensive certification tests in civil aviation annals before the jetliner enters service in the last half of 1959."

Two hours before the DC-8 took off a Boeing 707-120 flew across the Long Beach airport, a gesture which appropriately symbolized the operational rivalry which will exist between these two transports during the next decade or more.

Unlike the 707, which is several months ahead of the original Boeing schedules, the DC-8 has fallen a little behind: the first flight was originally scheduled for last March. However, Douglas are confident that certification will be completed on schedule by October 1959.

THE GUILD DINE OUT

AT the Dorchester Hotel, London, on May 28, nearly three hundred freemen and guests of the Guild of Air Pilots and Air Navigators were welcomed by the Master and Wardens to the Guild's annual banquet. Speakers included the Master and immediate Past Master of the Guild, Sir William Hildred, director-general of I.A.T.A., and the Rt. Hon. the Viscount Knollys, chairman of Vickers, Ltd., who presented the Guild's awards for individual or collective feats of skilled piloting or navigation during the past year. In characteristic vein, Sir William Hildred offered high praise to G.A.P.A.N. from I.A.T.A., and he reminisced upon his own travels about the world with various pilots in his position as director-general of the airlines' association. The forerunner of the much-discussed I.A.T.A. sandwich, he said, was a 2ft × 2ft × 2ft box with which he was presented while being ferried in a Liberator during the war. He ate 67 of the sandwiches it contained before two air marshals joined him for lunch. . . .

The Master of the Guild, Sir Frederick Tymms, took up a point of Sir Hildred's—that G.A.P.A.N. should continue to foster character and responsibility in its members—by outlining what had been done to raise standards of instruction. He told his listeners that, following a deficit, fees had had to be raised in the past year. He concluded by mentioning that the Guild had outgrown its headquarters in Londonderry House, and that for the convenience of freemen new accommodation would probably be found elsewhere in the West End.

Presenting the awards, Viscount Knollys appealed for continued Government support of the British aircraft industry to overcome "crippling development costs" of new aircraft—much as had been done in the U.S.A., where Electras had been ordered in quantity for air reconnaissance. "The reorganization of the industry," he said, "depends upon assurance for the future." The Cumberbatch Trophy for reliability of air operation, or development of aids to safe flight, was presented to Malayan Airways, who have had a ten-year accident-free record. The award was received on the airline's behalf by Capt. R. P. Mollard.

The Derry and Richards Memorial Medal for the best achievement in experimental flying during the year was awarded to Mike Randrup, chief test pilot of Napier (who was unfortunately unable to be present at the dinner), and the Johnston Memorial Trophy to S/L. J. H. Lewis, whose award is recorded on page 786.

The Cumberbatch Trophy, the safety award presented annually by the Guild of Air Pilots and Air Navigators, is here being accepted on behalf of Malayan Airways by Capt. R. P. Mollard at the Guild's annual dinner in London last week (see news item on this page).

B.O.A.C.'s COMET PLANS

THOUGH B.O.A.C. are still saying nothing officially about the date on which they hope to introduce Comet 4s into North Atlantic service, it now seems possible that a service will be inaugurated in October of this year. This news was revealed in a "confidential" notice to pilots, issued by the management last week, and reported in three national newspapers.

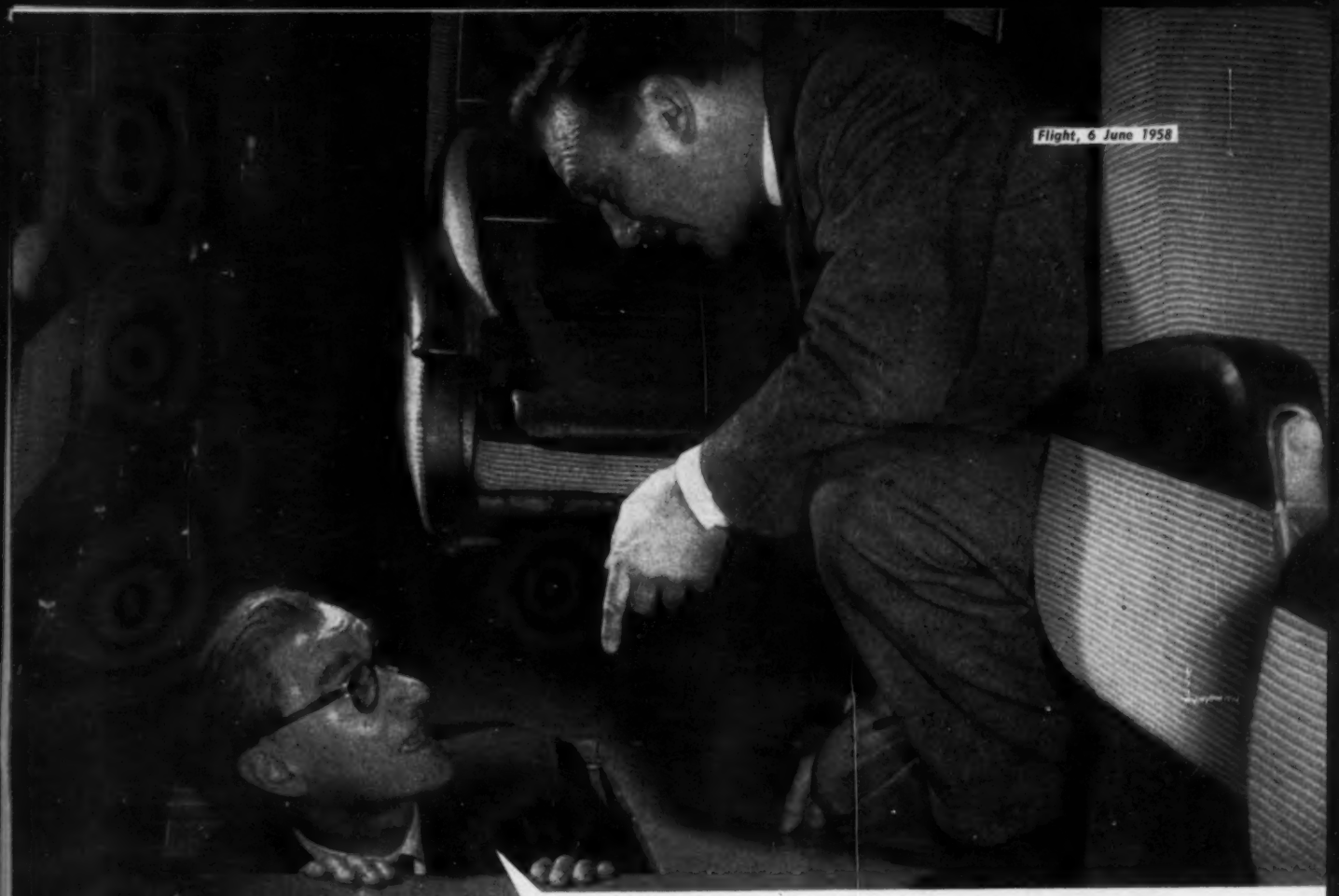
The same source—which was not apparently a firm statement of Corporation policy—suggested that the service in October will be of a token nature, and that regular daily *Monarch* services between London and New York will be introduced by Comets in January. In the following May, according to the statement, it is possible that Comets will take over Tokyo services from Britannia 102s, and December 1959 may see Comets operating the *Kangaroo* service to Sydney. (Under B.O.A.C.'s original plan, the Comet 4 was to have been introduced on to the London - Australia route first—in February 1959. The fact that this route may not now be operated by Comets until the end of 1959 indicates that Qantas' Boeing 707-120s will have a jet monopoly of the partnership-service for perhaps six months.)

PanAm's transatlantic 707-120 plans are still subject to commercial security, and to the outcome of certification trials and Port of New York noise-tests. It will be surprising, however, if the American airline is able to inaugurate even token jet services before B.O.A.C. According to the American publication *Aviation Daily*, PanAm are considering the possibility of using 707s on scheduled cargo services between Baltimore and Puerto Rico, to gain operational experience before the completion of certification tests (now scheduled for July 18).

VISCOUNT SALES REACH 390

A NEW order and repeat orders from four companies have brought the total of Viscount sales to 390. As announced in *Flight* last week, Ansett-A.N.A. have confirmed their order for V.810s. The British independent, Hunting-Clan, has now placed orders for three 810s to supplement their V.732s. These will carry the customer-identification number 833 and will be delivered in the "first part" of 1959. Hunting intend to avail themselves of the more powerful Dart 541s that will be available in 1960 and which form the basis of the 400 m.p.h. Viscount.

B.E.A. have ordered a further V.806, which will increase their total fleet of this type to 19, and Aer Lingus will add a further three V.808s to the three they now operate. Another repeat order has been placed by Capital, who have asked for an additional V.745 to bring their total of this type to 60. The order standing against Black Lion Aviation (V.825) no longer appears on the order book.



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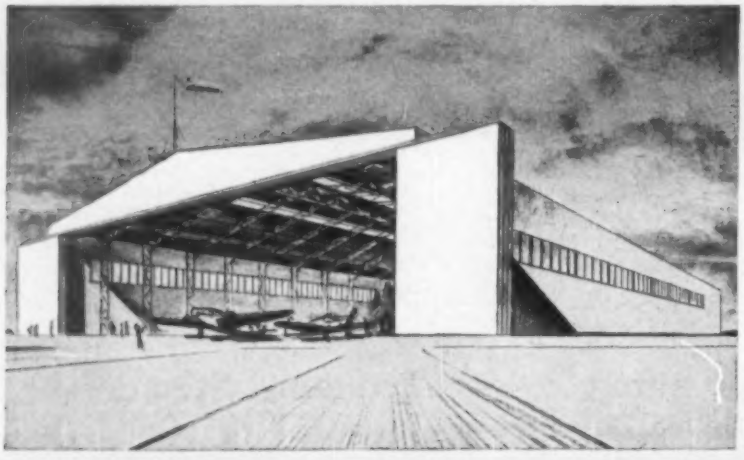
Branches: London, CHAncery 4971
Glasgow, Central 6208 · Manchester, Central 7904
Newcastle upon Tyne, Newcastle 26867
Leeds, Leeds 30867 · Liverpool, Central 0230
Wolverhampton, Wolverhampton 21912
Nottingham, Nottingham 42403
Bristol, Bristol 21781
Southampton, So'ton 23328
Brighton, Brighton 28497

SW/16



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CIVIL AVIATION . . .

Planned Air Transport Production

IT can too easily be forgotten that, among other things, airlines are engineering units concerned with the large-scale production of seat-miles and ton-miles. Production planning and control developed in other fields of engineering are as appropriate to the air transport industry as to any other.

THE price-fixing activities of I.A.T.A. have been responsible of late for stimulating a rising crescendo of criticism against that body. It is timely to recall the valuable service which I.A.T.A.'s officials are continually rendering the airline industry: the recently concluded four-day conference on Production Planning is a case in point.

This was held at I.A.T.A.'s Technical Liaison Office in London on May 19-22 and was the first occasion on which the Production Planning and Control Group was convened. Last March a questionnaire was distributed to member airlines in which replies were sought to 29 questions: the first asking what were considered to be the "objectives" for Production Planning and Control (P.P.C.), the remaining questions seeking to establish the "scope" of P.P.C. within each airline. Eleven carriers—Aer Lingus, Aero O/Y, B.E.A., C.P.A.L., J.A.L., K.L.M., Pakistan International, Sabena, S.A.S., T.C.A., and T.W.A.—replied in detail, their comments being compiled by I.A.T.A. and distributed at the conference together with a paper by B.O.A.C. on the philosophy and principles of P.P.C. Representing 15 member airlines were delegates from Canada, Europe, Asia and Africa. United States airlines did not attend as the subjects under discussion were already being examined by the Air Transport Association.

In addition to discussion arising out of replies to the questionnaire, the meeting listened to and commented on papers presented by airline experts on manpower-planning, incentive-schemes, budgeting, cost analysis, materials-provisioning, operations-research and automation. This airing of views on various aspects of production planning threw light upon the legitimate differences in approach followed by different operators: the ideal course for a large airline with high labour costs probably being quite unlike that for a small carrier paying low average wages. Another problem which soon became apparent was that of definition. Not only do terms such as Queueing Theory, Monte Carlo Method and E.D.P. understandably need explanation, but even such straightforward expressions as "material standards" require elucidation. Nevertheless, within these limits, a wide area of agreement was voiced concerning the purpose of P.P.C., perhaps the neatest definition being that provided by B.E.A.: "to relate the maintenance and overhaul requirements to the operational requirements as economically as possible."

The course of discussions fell into five sections: forecasts, processes, technical-analysis, organization and general.

All airlines appear to maintain formal operating plans, frequently covering as long a period as five years, in addition to which half-yearly programmes are usually drawn up on the basis of individual aircraft types (or, in the case of smaller carriers, individual aircraft). The operations plan is normally the basic foundation for the technical plan, this in turn being usually in the form of a production forecast showing a timetable for aircraft checks, overhauls and modification.

Airlines showed less agreement on the processes involved in P.P.C. As regards methodization of technical procedures the usual aim was 100 per cent coverage, although different operators varied in the degree to which this goal had been approached. Those with incentive schemes have made the greatest progress with methodization and with measurement of work content. In certain cases labour standards have been implemented in workshops only and not yet introduced into the hangars. Standards were usually drawn up by supervisory staff, although in a few cases they were evolved from time and motion study. The measurement of material standards—in the sense of established material consumption rates for given jobs—was surprisingly varied. Again the larger airlines tended to have developed this technique furthest, although there was a noticeable trend towards its more widespread adoption. Nevertheless, a few large airlines still appeared to have no system for measuring either the labour or the material content of particular jobs. The procedure for spares provisioning (this was the subject of a separate paper by B.E.A.) varied considerably, in some cases responsibility for this being centralized, in others distinction being made between initial purchase of spares for new aircraft, and subsequent purchase either of "rotable" spares or of aircraft overhaul spares. Procedure for handling of modifications, although formalized, were even more varied. Maintenance and overhaul is invariably scheduled in advance, responsibility for progress-checks and job-allocation resting either on supervisory or on planning staff.

Analyses of current production are normally published monthly or weekly, frequently in graphic form, and give details on such matters as employment, distribution of man-hours, productivity indices and variations from standards. This information is related to costs of labour and material and measured against the technical budget. As a general rule, cost-statements are distributed within the organization to those individuals and groups bearing a responsibility for the particular costs involved.

There appeared to be no set pattern for the organization of P.P.C. within each airline. Among most of the larger carriers, a P.P.C. section functions as a separate part of the engineering division. K.L.M. and S.A.S. are exceptions with scattered planning and control units attached to various departments. Necessary as P.P.C. departments might be to the larger, more complex airlines, their organization appears impossible to "miniaturize" without a loss of function. Consequently the small carriers find need for a "jack of all trades" capable of co-ordinating the various production activities.

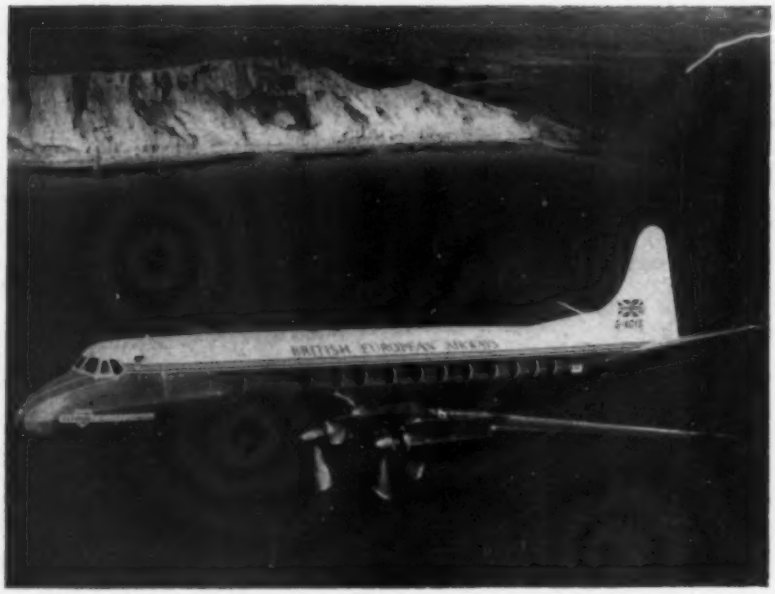
A surprising feature arising out of the discussion was the small number of airlines employing specialist techniques such as time and motion study, operations research and automation. Punch card equipment (installed primarily for accounting purposes) is in fairly general use, while electronic data processing (E.D.P.) is being increasingly adopted. However, as a Canadian Pacific representative pointed out in a paper on this subject, "an E.D.P. installation of any appreciable size can only be profitably employed when a volume of 30,000 bits of information per day is available." Of those airlines present, only S.A.S., K.L.M. and B.E.A. operated incentive bonus schemes. In a paper presented by S.A.S. on such schemes it was shown that, contrary to popular belief, these generally result in improved quality. An indirect but important further gain is the mass of data made available. This permits even more accurate work-standards to be evolved and greatly facilitates forward planning.

An important point that emerged towards the end of the conference was the need for a "fully integrated approach" to airline planning problems, particularly if the full potential of new aircraft types was to be successfully exploited. The jet era calls for a "totality concept" of planning which embraces every aspect of an airline's activity.

Before adjourning, it was agreed that the Group would meet again next January.

Formating over Mt. Rainier, familiar backcloth to Boeing's air-to-air pictures, are the first and third production 707-120s. Certification target date of this 707-series is now July 18, five months ahead of the Boeing schedule published a year ago.

CIVIL AVIATION . . .



Beachy Head and a B.E.A. Viscount 806 combine to form a pleasing portrait of the aircraft which this week has been the subject of the unique meeting discussed below. The picture was taken last week by one of "Flight's" staff photographers.

Viscount Operators Meet

BETWEEN June 3 and June 5 Vickers were due to be hosts, for the fifth consecutive year, to 33 representatives of the world's 37 Viscount operators. Between 60 and 70 senior engineers were expected to attend: this article discusses the background to a unique kind of customer-service.

IT was Sir George Edwards, managing director of Vickers-Armstrongs (Aircraft), who once said—in so many words—that a major transport has to be in operation for five years before its makers can begin to feel successfully established in the civil airline business.

To get into the business a firm must obviously have a good product: to stay in the business it has to demonstrate its ability to support that product. The term support, as used by the Americans, is something more than routine customer-service. It is the expression of the old adage that when a customer buys an aircraft, he buys its manufacturer, too. The phrase, "operational feedback," often heard within Vickers, well defines the basic ingredient of successful support.

A document which Vickers recently compiled for the 37 operators of the Viscount is the embodiment of all this. The authors are the operators themselves; their engineers were invited by Vickers to submit their individual problems and troubles for comment and discussion on Vickers' ground. This procedure is believed to be unique; its practical benefits and the goodwill it engenders are self-evident. Of the 37 operators of the Viscount, 33 were due to send senior engineers—68 all told—to the Sixth Viscount Operators' Meeting at Weybridge, which was expected to end yesterday, June 5.

The document referred to was to be the agenda of this meeting, and was to be dealt with in four sessions totalling 11 hours. The meeting was to take the form of replies and comments by senior specialists from Vickers' design organization and other departments, and by senior representatives of Rolls-Royce and Rotol, followed by discussion and exchange of views among the operators. The chair was to be taken by Mr. Derek Lambert, Vickers' assistant general manager (development).

The document itself refreshingly epitomizes the truth about the operation of airliners. Gloss and glamour have no place in a discussion amongst engineers, who have no illusions about the fact that aeroplanes—however conscientiously engineered—give trouble. This document, therefore, depicts the Viscount in its most troublesome demeanour, being the corporate snag-sheet of 37 operators whose engineers live and work with the aircraft in almost every kind of operational environment. Studied in this light, the document makes the virtues of the Viscount shine more brightly. Boiled down, it shows that 37 critical Viscount operators (who are presumably no less hard to please than the operators of other aircraft) submitted an average of less than five complaints apiece.

The document is divided into 21 sections, as follows (in parenthesis after each subject is given the number of questions raised about that subject): Hydraulic system (7); undercarriage, wheels and brakes (2); pressurization and air conditioning system (13); anti-atmospheric systems (3); fuel system (9); powerplant (3); engines (22); propellers (4); operation and performance (4); electrics (28); radio and radar (4); instrumentation (7); general structure (7); fuselage structure (13); wing structure (7); nacelle structure (3); flying controls (10); flaps (4); furnishings (6); water system (5); modification procedure (9); miscellaneous (5).

The actual questions vary from the important to the trifling. Most of them illustrate the kind of problem which only operational service reveals, and which design offices could not reasonably be expected to foresee—though the wisdom conferred by hindsight always suggests that it should have been. Typical questions and comments follow:—

The outflow valves part no. 13019-2 NA and 13019-NA work erratically, due to nicotine tar deposit.

Comment: Experience of nicotine deposit on the seats of discharge valves has shown that it is hard, and not "tacky." Valves so contaminated do not normally adhere to the seat, and blockage due to the deposit is merely compensated by the valve automatically assuming a slightly more open setting. It is thought, however, that these deposits, combined with the high humidities experienced by [the particular operator], may create different conditions, and Vickers would like further information.

(*a*) *Have the troubles experienced on engine fuel pumps when using wide-cut fuel been reduced?*

(*b*) *The engine-driven fuel pump life of 1,000 hours is unsatisfactory. What is the experience of other operators?*

Comment: An improvement in fuel pump slipper-pad life with this fuel (JP4) has only been achieved by tighter quality-control on pump slipper-pad to spherical fit on overhaul. A service trial has been run on copper beryllium slipper-pads but has not been satisfactory; a further trial is now in operation using Canadian-manufactured copper beryllium. Further trials are about to commence on improved spherical ball end finish. The Rolls-Royce recommended life on kerosine is 2,500 hours, with service units on trial to higher lives; one operator has already achieved an established life of 3,200 hours.

What is the latest position with regard to aircraft vibration? Do Vickers, Rotol or Rolls-Royce have a programme to isolate the cause of recurring vibration?

Comment: The position regarding aircraft vibration is virtually unchanged. Joint meetings have been held in order to formulate a programme of special flight testing, and this matter is still under consideration. Engine order vibration is restricted to cases where rotating components have failed, and in a few isolated cases, of faulty overhaul technique.

It would be appreciated if Vickers would overhaul the present system of classification of modifications with a view to eliminating confusion, which now arises frequently. Most large American factories do not have a classification at all. Modifications are mandatory by C.A.A. only.

The present system of information on modifications, i.e., modification bulletin, modification leaflet, modification index and preliminary modification bulletin should be combined into one document.

Comment: In view of operators' criticisms of the modification procedures in operation, the system is being examined with a view to simplifying the classification of modifications, and hence eliminating the apparent confusion that is reported to exist as to whether a specific modification is absolutely necessary for a particular operator's aircraft. It has been policy in the past to issue a Modification Bulletin for a given alteration, as soon as technical details are available irrespective of the availability of the required new equipment or parts. By this means it was hoped that information would be provided to facilitate forward planning on the part of the operator. However, it is hoped that this anomaly regarding modifications will be fully discussed at the forthcoming meeting with a view to providing constructive comment for improvement. A statement regarding the proposed reclassification of modifications will be made at the meeting.

An analysis of the sources of all the questions (which amount to 170 in all) is revealing. The following list gives the number of queries raised by individual operators. (In parenthesis is shown the approximate number of hours flown by that operator.) Some complaints were common to several operators, but are nevertheless counted separately:—

B.E.A., 41 (240,000 hr); Aer Lingus, 2 (28,000 hr); T.A.A., 31 (75,000 hr); T.C.A., 37 (155,000 hr); Hunting-Clan, 2 (4,000 hr); Airwork, 12 (9,000 hr); Capital, 32 (292,000 hr); C.A.A., 1 (16,000 hr); Hong Kong Airways, 9 (3,700 hr); Indian Airlines Corporation, 31 (4,700 hr); Philippine Airlines, 14 (1,600 hr); Alitalia-L.A.I., 5 (7,600 hr); K.L.M., 3 (4,500 hr); Transair, 1 (1,700 hr); N.Z.N.A.C., 1 (450 hr).

Of particular interest is a breakdown of questions which can fairly be laid at the door of the constructors of the airframe, engines and propellers, as compared with the number for which ancillary suppliers are responsible. Obviously, a prime constructor is always answerable for the ancillaries which he chooses to install: the fact that 36 per cent of all the queries listed in this document is the responsibility of suppliers is of academic interest to the operators. The breakdown appears to be roughly as follows: Aircraft constructor, 83 queries; engine constructor, 22; propellers constructor, 4; ancillary constructors, 61.

NORTHEAST'S BRITANNIAS

PUBLICATION of Northeast Airlines' annual report has evoked a flood of speculation on that carrier's re-equipment intentions. Sentences from one particular section of the report have been so widely taken out of context that it is appropriate to quote the relevant paragraphs in full:—

"Your management still thinks well of the turboprop Britannia, its passenger appeal and performance characteristics. These planes are ideally suited for first-class service in the Florida market and would complement our ten DC-6B Sunliners now operating in coach service. Accordingly, Northeast's present contract with Bristol Aircraft, Limited, has been modified and extended to cover delivery of the planes in the fall of 1958.

"Among the terms agreed upon, the manufacturer has until May 1, 1958, to obtain an American certificate, and, if certification is completed prior to that time, your company has 60 days in which to arrange the necessary financing and secure the consent of its lending banks to the purchase."

The present position is that a firm order has been placed for five Britannia 305s, valued at $17.5m, to include engines and spares. Advance payments of $456,501 had been made by last December, of which $357,000 could be recovered, were the contract cancelled. Certification was obtained on April 10.

The hesitations arise from the fact that any financing agreements concerning the Britannias must be consented to by Northeast's major creditors (the banks responsible for financing the purchase of DC-6Bs in 1955. Unfortunately for the airline (again quoting the annual report), by the end of last year, "the company was in default under provisions of the [DC-6B] credit agreement requiring the maintenance of minimum amounts of net worth and or working capital and, as a result, the banks may accelerate the due dates."

Aviation Daily, discussing Northeast's Britannia order, says "prevailing opinion is that Northeast will not be able to make it." This comment must be assessed in the light of the foregoing facts. Certainly a glance at Northeast's balance sheet indicates that, though the airline's financial position is not critical, its resources are strained to the limit.

BREVITIES

TO investigate the possibilities for the AW.650 Freightercoach and its variants in South America, a sales team led by Mr. C. S. Emery, Armstrong Whitworth's sales director, left Britain on June 1. He was accompanied by Mr. D. L. Raffle, chief performance engineer, and Mr. M. E. L. Spanyol, assistant to the civil aircraft designer.

* * *

Mr. C. R. Smith, president of American Airlines, said last week that his company expects to complete arrangements for the purchase of medium jets during 1958.

* * *

The Tu-114D, a modified version of the Tu-114, recently completed a non-stop 5,280 st. mile flight from Moscow to Irkutsk and back at a claimed average speed of 497 m.p.h., and at altitudes between 33,000 and 40,000ft. The return flight encountered headwinds of up to 125 m.p.h., but sufficient fuel remained on landing for the aircraft to fly a further 930 to 1,240 miles. The pilot was Viktor Ivanov.

* * *

Costa Rica has now become a member state of I.C.A.O. Total membership is now 73.

* * *

G.E.C. have secured a £25,000 order from S.A.S. for 100 air-circulation catering ovens.

* * *

From May 31 a Saturday return service between Newcastle and London has been operated by B.K.S.

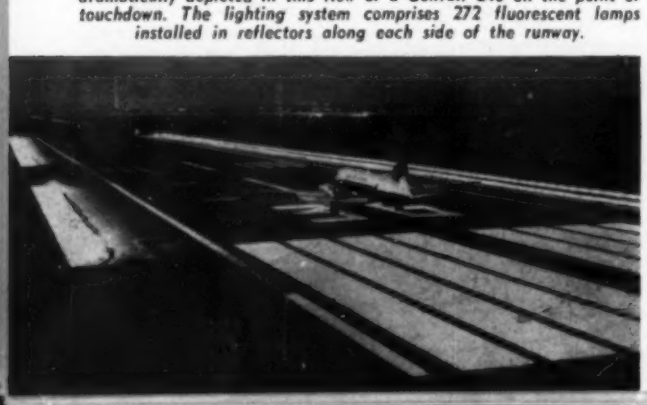
* * *

An Avro York of the British independent airline Dan-Air crashed near Gurgaon, 25 miles from New Delhi, on May 25. Of the crew of five, only the radio officer survived.

* * *

G.A.P.A.N. announce that as from July 1, 1958, fees for instructor's certificates will be as follows: initial application, £4 4s; re-test, £3 3s; renewal, full instructor, 15s; and renewal, assistant instructor, £1 1s.

The new runway-lighting system at Washington National Airport is dramatically depicted in this view of a Convair 240 on the point of touchdown. The lighting system comprises 272 fluorescent lamps installed in reflectors along each side of the runway.



GATWICK (continued from page 774)

the aerodrome control room (surrounded by sloping triple glazing) is built on two levels; the lower level will only come into full play when daylight viewing radar is installed. At the moment there is one radar set used only to feed aircraft into the traffic pattern controlled by the Southern Air Traffic Control Centre at London Airport. Approach control is situated in a room under aerodrome control. Emphasis has been laid upon clear radar presentation of aircraft position and the operational rôle has been planned around the dual displays of the Cossor ACR 6 10cm and Marconi S232 50cm radars. Both are equipped with Moving Target Indication and rain removal aid, and the wavelength variation of the two sets provides definition irrespective of the weather. An additional facility is video mapping, which can be superimposed on the radar screen to assist in position identification. The approach control room operates in semi-darkness, but special artificial lighting is provided to illuminate the control desks carrying the flight progress strips. The desks are of M.T.C.A. design and embody the results of many years of practical operating experience. It is intended to make extensive use of radar sequencing at Gatwick, even in V.M.C., since it has been found that the landing rate can thus be appreciably increased. Just what level this may reach must remain a matter for conjecture until the system is in full-scale use; air traffic control are not willing to hazard a guess until the system has been tried.

In the approach control room space has been left clear to add to the installations precision approach G.C.A. radar. At present this is contained within a truck at the edge of the runway, but later a landline will be adopted that ties the display to a remote-mounted aerial head.

Communications systems at Gatwick include radio and navigational aids to aircraft, radio communication facilities and fixed services—among them a semi-automatic signals centre and telephone facilities and the STRAD (Signal Transmitting Receiving and Distribution system) fully electronic teleprinter exchange. The system will handle 3,000 messages daily. The radio communication facilities follow the pattern at L.A.P. Central. Aeronautical V.H.F. speech channels are duplicated to provide main and standby services and special precautions have been taken against failures due to interruptions.

Gatwick is also the first airport to use a multi-channel tape recording system (manufactured by the British Communications Corporation) with which M.T.C.A. are replacing the single channel embossed film type of recorder. The equipment will record seven communications channels on a single tape and an extension to fifteen channels is possible.

Among the more important fixed installations is the Esso and Shell-Mex and B.P. fuel farm on the north side of the apron. Fixed hydrants have been abandoned in favour of mobile fuellers carrying the four grades of aviation fuel—100/130, 108/135 and 115/145 octane and DERD 2482 turbine fuel—that are available. The Esso installation contains 12 fuel tanks each holding 12,000 Imp. gal and the Shell-Mex and B.P. installation has a similar fuel capacity. Provision is being made for dispensing aviation lubricants and water methanol.

The first commercial service into Gatwick has already become Transair history; B.E.A.'s inaugural flight, on June 9, is to be a charter to Surrey County Council, who have arranged for a DC-3 to fly a V.I.P. party and a message of goodwill to the States of Jersey and Guernsey. Subsequently there will be 162 departures and 163 arrivals a week by B.E.A. DC-3s and Viscount 802s to and from the Channel Islands and a few additional DC-3 flights to Salzburg.

A. T. P. and J. C. S.

SERVICE AVIATION

Royal Air Force and Naval Flying News

Birthday Fly-past

WITH the Queen taking the salute from the balcony of Buckingham Palace, sixteen Javelins of R.A.F. Fighter Command are to fly past at 1300 hr on Her Majesty's official birthday, June 12. The aircraft, in four boxes of four in line astern, will be led by G/C. D. G. Lyster, C.O. of R.A.F. Stradishall, with W/C. G. A. Martin (C.O. of 89 Sqn.) as deputy leader. The other two squadrons represented in the formation will be Nos. 23 and 41, both based at R.A.F. Coltishall.

French Tour

DURING his recent visit to France the C.A.S., Marshal of the R.A.F. Sir Dermot Boyle, went to the flight test centre at Brétigny and flew from there to Mont-de-Marsan by Caravelle. He visited the Air School at Salon-de-Provence and also the Défense Aérienne du Territoire installations.

O. C. Butterworth

COMMAND of the new R.A.A.F. base at Butterworth in Malaya was taken over as from June 1 by G/C. K. R. J. Parsons with the acting rank of air commodore. Three R.A.A.F. squadrons are being based there, Nos. 3 and 77 (equipped with Sabres) and No. 2 (Canberras).

Coastal Command Trophies

AT R.A.F. St. Eval last Friday the A.O.C-in-C. Coastal Command, Air Marshal Sir Bryan Reynolds, presented the Dunning Trophy and the Aird Whyte (swimming proficiency) Trophy to No. 228 Sqn. The Dunning Trophy is awarded for the highest proficiency in A.S. training and was won last year by No. 120 Sqn.; the Aird Whyte Trophy for swimming (not to be confused with the award of the same name for bombing and gunnery) was first presented in 1955.

G.M. Award

NOW with No. 269 Sqn. at R.A.F. Ballykelly, Sgt. L. G. Birnie has been awarded the George Medal for his gallantry in saving the life of a fellow crew member when a Shackleton in which they were on a training flight crashed at Kinloss last January. Sgt. Birnie and three other members of the crew had escaped from the burning aircraft through a hole in the fuselage when he realized that two other crew members had not been accounted for. He then went back into the wreckage and got one of them out. In the words of the official citation, "There is no doubt that Sgt. Birnie's gallant action, which critically endangered his own life, saved the life of his comrade."

Good Neighbours

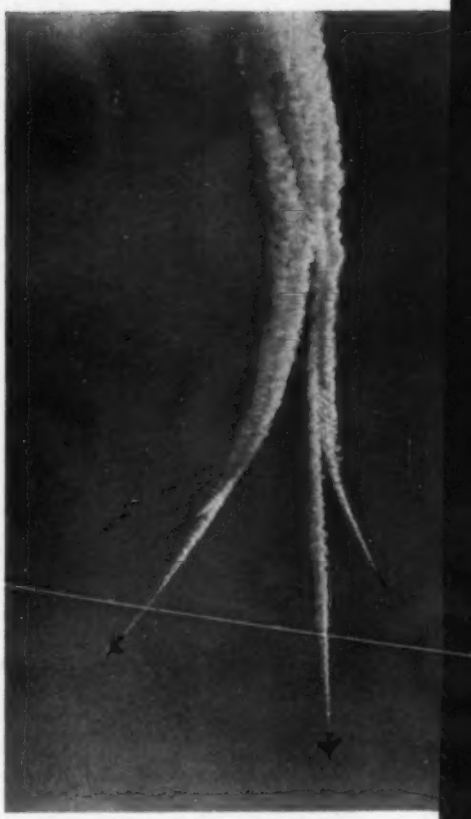
TO mark nineteen years of friendly associations between R.A.F. Stanbridge and the town of Leighton Buzzard, a dinner was held recently—on the anniversary of the opening of the station as a radio communications unit—and presentations were made. G/C. J. Cherrill, the station commander, gave the Urban Council a reproduction of the unit badge in the form of a plaque; and the chairman, Cllr. Mrs. M. Brown, presented G/C. Cherrill with an illuminated and framed resolution expressing the town's friendship and goodwill towards the station.

Air Chief Marshal Sir Walter L. Dawson, Member for Supply and Organization, represented the Air Council at the dinner; and No. 90 (Signals) Group, which controls the station, was represented by its A.O.C., A.V-M. L. Dalton-Morris.

Recent Postings

AMONG appointments recently announced by the Air Ministry are the following:—

W/Cs F. J. Cuthill to No. 2 Police District, for provost duties; J. A. Sherry to H.Q., Coastal Command, for technical staff duties; E. F. Wisdom to H.Q., No. 40 Group, for air staff duties; A. E. Anderson to Air Ministry, for duty in the Department of the Air Member for Personnel; A. S. Mohan to Air Ministry, for duty in the Department of the Air Member for Supply and Organization; A. E. G. Pye to H.Q., No. 3 Group, for technical staff duties; G. I. Pawson to R.A.F. St. Athan, for administrative duties; W. L. Clarke to R.A.F. Sylt (Germany), for technical duties; G. R. Cook to No. 113 M.U., to command; H. H. C. Hester to R.A.F. Little Rissington, for technical duties; G. F. McMahon to H.Q., British Forces Arabian Peninsula, for provost staff duties; P. W. Nunn to R.A.F. Thorney Island, for technical duties; G. N. Street to Air Ministry, for duty in the Department of the Air Member for Supply and Organization; L. H. Styles to H.Q., 2nd T.A.F., for administrative staff duties; H. M. H. Tudor to R.A.F. Staff College, Bracknell, for directing staff duties; G. Young to R.A.F. St. Mawgan, for flying duties.



Four from nine leaves five: No. 111 Sqn. Hunters showing off their spectacular new breakaway routine in the R.A.F.A. display at Hucknall on May 26 (report, pp. 764-5). "Flight" photograph

S/L. J. H. Lewis (right), C.O. of the R.A.F. Antarctic detachment and captain of the DHC Otter on its trans-Polar flight receiving the Johnston Memorial Trophy—for "the most outstanding performance on record of air navigation for the year"—from Viscount Knollys, chairman of Vickers, Ltd., at the G.A.P.A.N. banquet on May 28.

IN BRIEF

Air Marshal Sir Edmund Hudleston, V.C.A.S., was among 13 NATO observers attending a recent U.S. nuclear test at the Eniwetok proving ground.

* * * * *

R.A.F. recruitment for the January-March quarter totalled 5,074, of which the number of those entering on nine-year or longer engagements—1,152—was more than double that in any of the three previous quarters.

* * * * *

Forthcoming fixtures announced by the Association of Service Yacht Clubs are the Seaview Meeting (July 5 and 6) and the Inter-Services Team Championship at Portsmouth (October 11 and 12).

* * * * *

A tie has been introduced for wear by officers and airmen who are serving or have served with No. 40 (Maintenance) Group It bears the Group emblem, a griffin and sword, in light blue and gold on a maroon background. The tie is obtainable only from T. M. Lewin and Sons, Ltd., 103 Jermyn Street, London, S.W.1, and costs 12s 6d in rayon, 15s 6d in terylene and 18s 6d in silk (postage 6d in the U.K. and 1s 6d for registered postage abroad).

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Cody and his Biographers

I WOULD sooner trust the accuracy of Mr. G. A. Broomfield's memory of Cody (*Flight*, May 16) than Mr. Charles Gibbs-Smith's (May 23) second-, third-, or fourth-hand knowledge gleaned from delving into ancient tomes.

Gibbs-Smith's touching faith in the infallibility of *The Times* of those days is so naïve! I remember so well how we laughed at the inaccuracy and downright wrongness of the aviation news published in the daily Press of those days.

The people in the Balloon Factory at Farnborough at that period were allergic to the Press and told reporters what suited them at the time; and Colonel Capper enjoyed leg-pulling, as also did Cody. They little realized that fifty years later there would be a Gibbs-Smith to swallow it all, hook, line and sinker.

How little he can visualize Cody is seen from his last sentence, in which he refers to him as the "old gentleman"! Cody was only 52 when he was killed in 1913.

London, S.W.5. GEOFFREY DORMAN.

WITHOUT taking sides in the discussion in print on Cody's first flight, may I make two points in a cautionary fashion concerned with Mr. Gibbs-Smith's statements?

He says: "There is no known contemporary account of the May 16 tests." But what he must mean is *known to him*: if the flight(s) took place, it is certain someone knew of them, and it is impossible for Mr. Gibbs-Smith to have had time to conduct a full-scale search in the ultimate sense of that term.

Secondly, to trace events through mentions in *The Times* of 50 years ago, and believe that there must lie the *fons et origo* of truth, displays a naiveté that is to be distrusted. *The Times* of 1908 was one of the worst *news*-papers: and was easily eclipsed and outclassed by many defunct publications such as the *Westminster Gazette*, the *Pall Mall Gazette*, and so on. Had Mr. Gibbs-Smith reported that the local newspapers of the time at Weybridge had no account; had he searched the local newspapers at Hendon and Eastchurch (where the spies were always on the *qui vive* for news of activities at rival camps); had he searched the secret archives of the War Office; and had he traced living people of the time and their descendants of today; had he done all this—which in the time he could not have done—then there might be weight to his views. But merely to quote *The Times* of yesteryear, giving that deadly Thunderer the zing and prestige of its current issues, is merely to fail to grasp the realities of the newspaper revolution of the past half-century.

Far more important is the general proposition that everything would have been written down—*ergo*, if it was not recorded in writing then the situation was *non est*. Nothing could be further from the truth.

London, W.1. B. J. HURREN.

REFERRING to Mr. Charles H. Gibbs-Smith's article in *Flight* for May 23, may I bring to your notice the *Journal of the Royal Aeronautical Society* for September 1954, in which it is laid down by no less an authority than Mr. Charles H. Gibbs-Smith that Cody made the first sustained flight in Great Britain on May 16, 1908. The paragraph reads as follows:—

"Here may we say with fervour that if Cody had been naturalized in 1908 instead of 1910, all the bitter nonsense about certain claims to be the first Englishman to fly would have been knocked decisively on the head, for Cody unquestionably made the first proper powered aeroplane flight in this country—powered, sustained and controlled—on May 16th, 1908, on his British Army Aeroplane Number One. He made five flights on that day over Laffan's Plain, the longest being 150ft, at a height of about 10ft. On the 5th October that year he flew 496 yds at about 50-60ft above the ground."

May I add that in consequence of this evidence I consider that the inscription to this effect should be restored to the plaque on the celebrated tree at Farnborough.

Virginia Water, Surrey. G. A. BROOMFIELD.

[Mr. Broomfield appends a number of cuttings from recent issues of *The Aldershot News*. One of them is a letter from Mr. Vivian Cody (S. F. Cody's son), who writes—referring to an earlier note in that newspaper—"I am afraid I did not explain clearly the first flights on May 16, 1908. There were five flights in all on the first day. The first was only a few inches from the ground to test the lift of the machine, the second, third and fourth were better than the first, but on the fifth run the machine left the ground for about 150ft, and reached a height of about eight feet, the highest point being about half-way along the flight."—Ed.]

Aircraft Electrical Systems

I WOULD like to refer to Mr. Lionel G. Hill's most interesting, but in my view misleading, article on "Electrical Systems in the Air" in *Flight* dated May 2.

Since I have been directly concerned with the test and development of an all-A.C. aircraft my remarks will be confined to some of the technical aspects of such a system, leaving others to deal with the remainder of the article.

In all constant-speed mechanical or hydraulic drives a free-wheel device is incorporated to prevent the alternator attempting to motor the engine. My experience with a particular hydraulic drive has shown that its free-wheel device, far from being a "bodge," has been trouble-free, and there is no tendency for alternators to fall out of synchronism even on full load switching.

As Mr. Hill remarks, accurate frequency control is not an insuperable problem; and, in fact from our experience on the system under test, the problem never existed.

Your contributor's notes on load-sharing appear to be somewhat confused. In the case of the system under test the governor only receives one signal relayed from a magnetic amplifier. It is the latter which receives the separate frequency and load-control signals. There is no doubt about the ability of the magnetic amplifier to sort out the signals. Moreover, the system is analogous to the voltage regulator on a D.C. generator which receives two signals; one from the voltage sensing gear and the other from the equalizing system.

As regards mismatched alternators, my experience has shown that the degree of mismatching arising from production tolerances, both on alternators and control gear, is quite acceptable. Both the real and reactive load-sharing obtained in our tests are better than comparable results from the most modern D.C. system. The protection system is engineered with unearthed current transformers, thus one earth fault on the protection lines will not cause system failure.

Mr. Hill's suggestion of a common constant-frequency reference is surely rather dangerous. What happens in the event of a failure of the reference, or is it duplicated? My experience of the multiple-reference system is that it works very well.

I cannot agree that it is difficult to arrange for aircraft loads to be in reasonable balance in all three phases—we have not found it so.

Mr. Hill does not appear to be aware that the Merz Price system, whilst detecting line-to-line and line-to-earth faults, does not detect an out-of-balance between phase currents. As previously mentioned, in a properly designed aircraft system large out-of-balance phase currents do not exist.

Admittedly I am only writing on the basis of actual test experience, but it is surely more valuable than the conjectures of your correspondent.

Stockport, Cheshire. J. C. PILCHER.

I MUST clear up some misconceptions which are bound to have arisen as a result of Mr. Hill's recent article. On what authority or first-hand experience does he base such rash statements about paralleled A.C. systems? I have been directing the efforts of a team—which does not include Mr. Hill—who for the past 18 months have been testing in the laboratory and in flight the first constant-frequency paralleled system in this country, so perhaps the opinion of one with practical experience in these matters will bear more weight than one who is just theorising.

I will not dwell on the misleading statements in the article, but wish to assure all prospective users of the constant-frequency system that it has survived rigorous flight testing, which include deliberate faulting in an attempt to induce complete loss of control and failure. As a result of these trials we have the confidence to install this equipment in an aircraft with electrically powered flying-control surfaces.

The suggestion that electrical engineers—any type of engineer for that matter—would allow political considerations to overrule his natural sense of responsibility is sheer bunkum. D.C., rectified A.C. and constant-frequency systems each have their own advantages, but it is the nature and amount of power required on an aircraft which dictates the best system to use.

One point in Mr. Hill's favour. I do admire his ability as a cartoonist.

Gatley, Cheshire. P. C. FINUCANE.

Atlantic Carriers

YOUR article headed "The Most Important Route" in *Flight* dated May 23 was very interesting; however, you mention Aerlinte as being the seventeenth carrier on the North Atlantic.

Surely you have overlooked Qantas, as they have been operating on this route since January of this year.

London, S.W.5. D. GRANTHAM.

[Including Seaboard and Western—the all-cargo airline—Aerlinte are in fact the eighteenth airline to compete for North Atlantic traffic —Ed.]

THE INDUSTRY

Computers in Service

TWO more Ferranti computers have recently gone into service, one with Blackburn and General Aircraft and the other with Armstrong Siddeley Motors. The computer at Brough is a Pegasus, employed not only on design work and performance-studies for the NA.39, but also on calculations for the company's engine division. Its work will be of an extremely diverse nature—aerodynamics, structures, aeroelastics, test flight and wind-tunnel data reduction, and basic geometric design and data for tangent planning of wind-tunnel models.

At Armstrong Siddeley Motors, Ansty, a Ferranti Mk 1 is working on engine performance calculations, prediction of compressor and turbine characteristics, whirling speeds and disc stressing. It is the fourth to be installed in the Hawker Siddeley Group.

Two brochures have recently been published by Ferranti, Ltd., describing the Pegasus and its magnetic tape equipment.

U.S.-Canadian Co-operation

A LINK between the U.S. designers and manufacturers of technical components and systems, the Kearfott Co., Inc., of Little Falls, N.J., and the Canadian instrumentation company Canadian Applied Research, Ltd., of Toronto, was announced recently. Under this arrangement, which follows a parallel link-up last September between the U.S. and Canadian parent companies, General Precision Equipment Corporation and A. V. Roe Canada, Ltd., Applied Research will act as exclusive Canadian distributor in Canada for Kearfott products (synchros, servomotors and gyros).

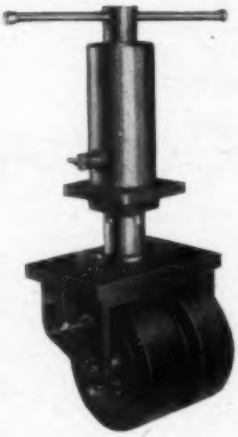
Draught Gauge

DESIGNED primarily as a draught gauge, a new draught and low-pressure gauge has been announced by Appleby and Ireland, Ltd., Kempshott House, Kempshott, Basingstoke. It has a single pointer, operating to various specifications (ranging from −1in to +1in water gauge, to zero to 1,000in w.g. full-scale deflection), and the instrument is said to have an accuracy of ±1 per cent of full-scale deflection. The movement consists of a capsule connected to a geared mechanism and the dials range in size from 6in to 10in in diameter.

Metal-spraying Equipment

A NEW metal-spraying gun has been introduced by the Metallizing Equipment Co., Ltd., Chobham, Woking, Surrey. Known as the Metco Type K metallizing machine, it is intended to meet a current demand for high-speed, semi-automatic production metal-spraying equipment. Some of its many uses include hard-facing the friction surface of clutch pressure-plates; building up large hydraulic rams, rolls, shafts and similar items with stainless steel; the production salvage of mis-machined parts; and high-speed deposition of zinc and aluminium for the prevention of corrosion.

The metal to be sprayed is in wire form and is passed through a nozzle where it is heated by an oxygen/gas flame. A blast of compressed air surrounding the wire nozzle atomizes and deposits the metal onto a prepared surface, the resultant deposit ranging from 0.001in to ¼in or more. The wire feed of the Type K machine is driven by a high-capacity electric motor, monitored by an electronic speed-control system which permits the adjustment of wire speed through the whole usable range. The power supply unit maintains constant speed.



Specially designed for certain applications in the aircraft industry, this new Flexello castor utilizes its makers' patented principle which allows full swivelling movement without affecting the jacking action. Capacity is three to four tons, overall height 40in and jacking range 3in. Timken taper roller bearings are used throughout. (Flexello Castors and Wheels, Ltd., Trading Estate, Slough.)

High-precision Bellows

A NEW range of high-precision barometric bellows in a variety of alloys is now being produced by Avica Equipment, Ltd., Hemel Hempstead, Herts. It is stated that a tolerance in spring-rate as low as ±10 per cent is possible on a production basis and, if required, dimensional tolerances of ±0.005in can be held on the external and internal diameters of the corrugations. Normal size-range is 3.8in to 12in bore, but no catalogue dimensions are specified, as these products will in many cases be supplied to customers' special requirements. A feature is made of complete, tested assemblies.

New British Standards

THREE new British Standards with aircraft applications have recently been published. B.S. S.123 for 55-ton, 3 per cent chromium-molybdenum steel for aircraft gives requirements for material up to a limited ruling section of 6in in the form of bars and billets for forging or machining and for forgings. (Reference is made to B.S. 2S.100 for details of the inspecting and testing procedures for the materials.) Copies of S.123 may be obtained from British Standards House, 2 Park Street, London, W.1, at 2s 6d.

The two other new standards specify basic dimensional requirements for inlet connections on aircraft for coupling to ground air-conditioning (C.10) and pressure-cabin ground test equipment (C.11). The B.S.I. points out that the handling of aircraft at international airports should be facilitated by the fact that some of the requirements in these standards are in line with recommendations by the International Organization for Standardization on aircraft ground servicing conditions.

Both C.10 and C.11 are illustrated and copies are available from B.S. House at 3s each.

IN BRIEF

Orenda Engines, Ltd., are to give technical assistance to the German B.M.W. company, which is responsible for engine maintenance of Canadian-built Sabres used by the West German Air Force. Under this new arrangement German operatives are to be trained both in their own country and Canada. Other news from Orenda is that Mr. Earl Redfern, formerly repair and overhaul superintendent, has now been appointed production manager. He joined the aircraft industry in 1939, at the aircraft division of National Steel Car in Malton.

Designed for guided-weapon and similar purposes, this Smiths Size 7 motor measures only 1.6in long by 0.6in diameter. No-load speed is 9,000 r.p.m. and stall torque 8 gm/cm. It may be driven from single-phase 26v (with 1.5 mf tuning capacitor) or two-phase 400 c.p.s. supplies.

An illustrated brochure giving full electrical and mechanical information on Series 400 selenium rectifiers has been published by their manufacturers, the rectifier division of Standard Telephones and Cables, Ltd., Edinburgh Way, Harlow, Essex.

* * *

Formerly with Philips Electrical, Ltd., Mr. S. F. Smith has recently taken up the appointment of sales manager for the industrial instruments division of Firth Cleveland Instruments, Ltd. He will operate in his new post from the company's sales department at Byron House, 7-9 St. James's Street, London, S.W.1.

* * *

A dynamometer capable of testing all known sizes of aircraft tyres at speeds of up to 300 m.p.h. and under loads up to 80,000 lb is to be installed at the Detroit tyre development laboratory of the U.S. Rubber Co., to which the North British Rubber Co., Ltd., is affiliated. The contact-wheel is 8ft in diameter, weighs seven tons and will be powered by a 1,250 h.p. motor.

* * *

British Nylon Spinners, Ltd., 25 Upper Brook Street, London, W.1, have just published a new edition (No. 8) of their Buyer's Guide, issued in two volumes, one for apparel and household uses of nylon and the other for industrial applications. The latter, rearranged for easier reference, is now divided into 70 major categories of products.

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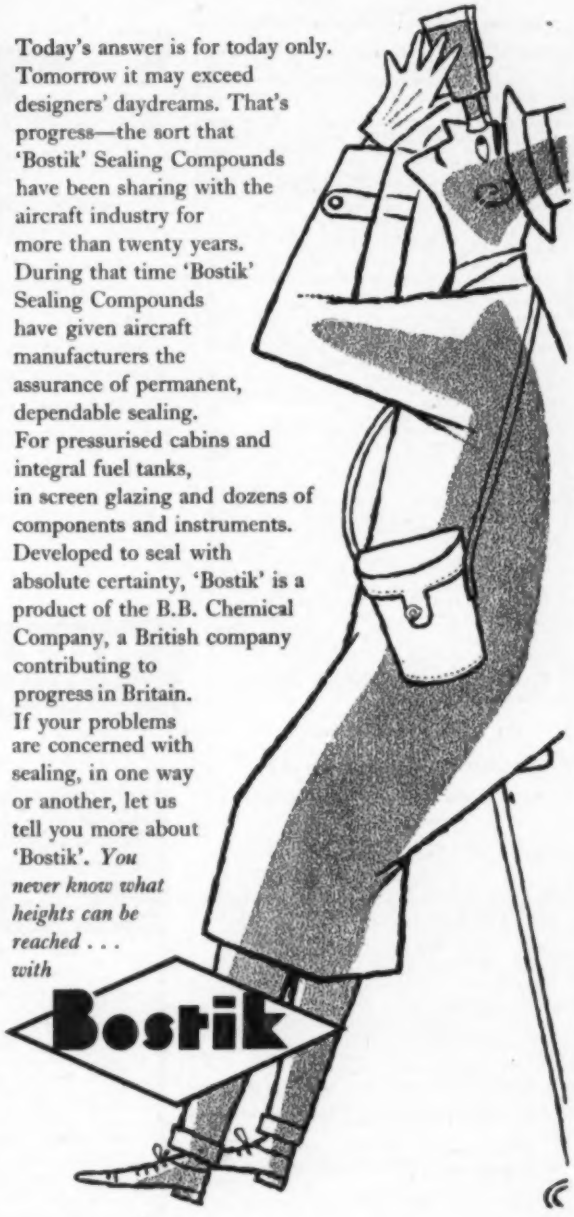

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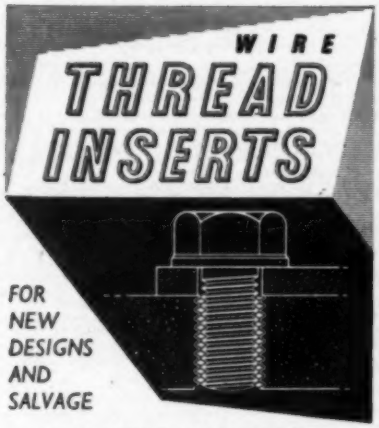

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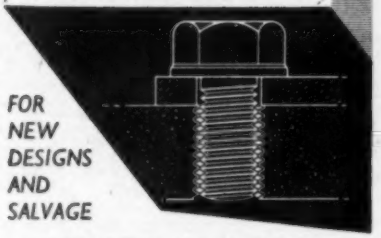

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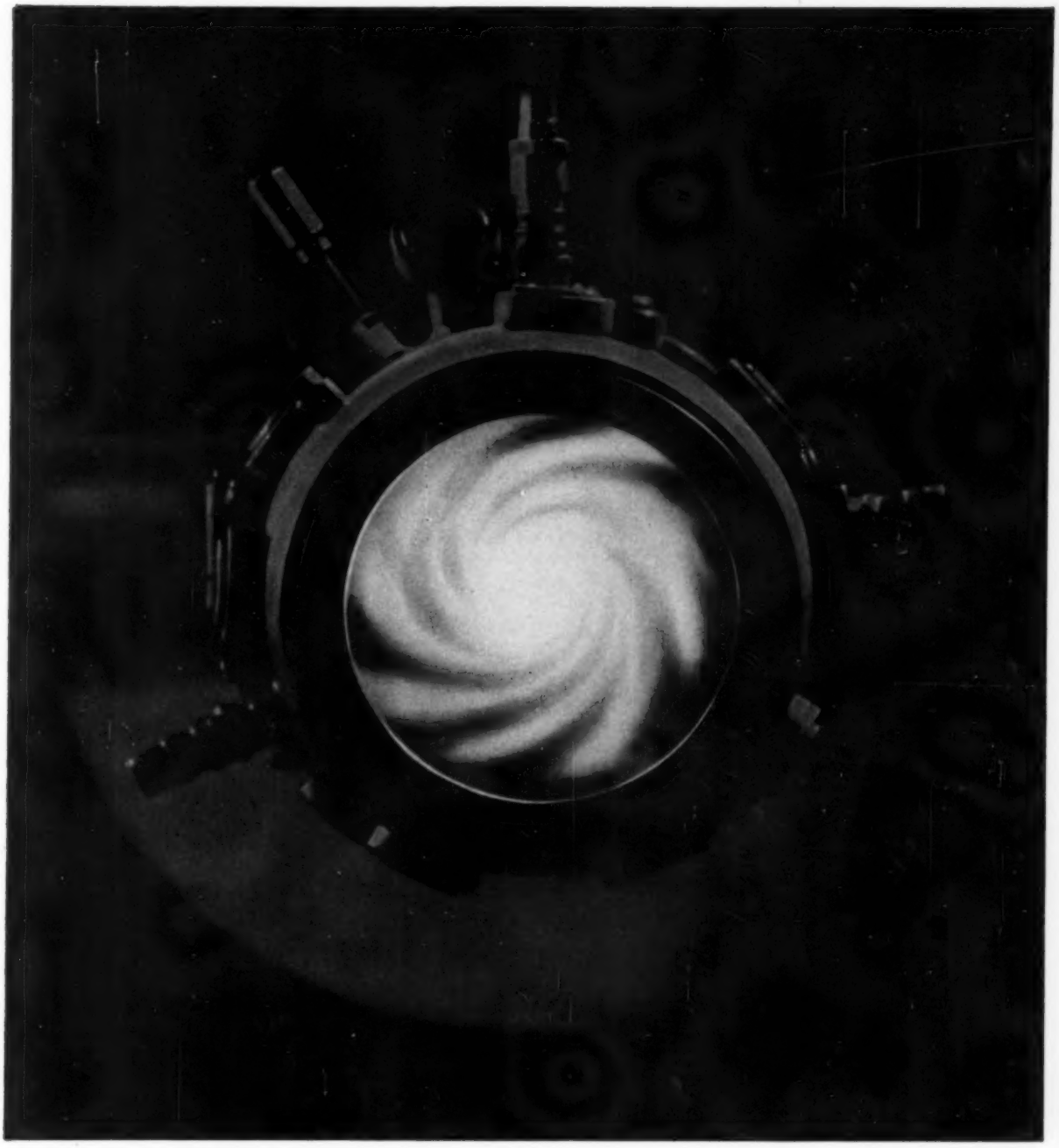

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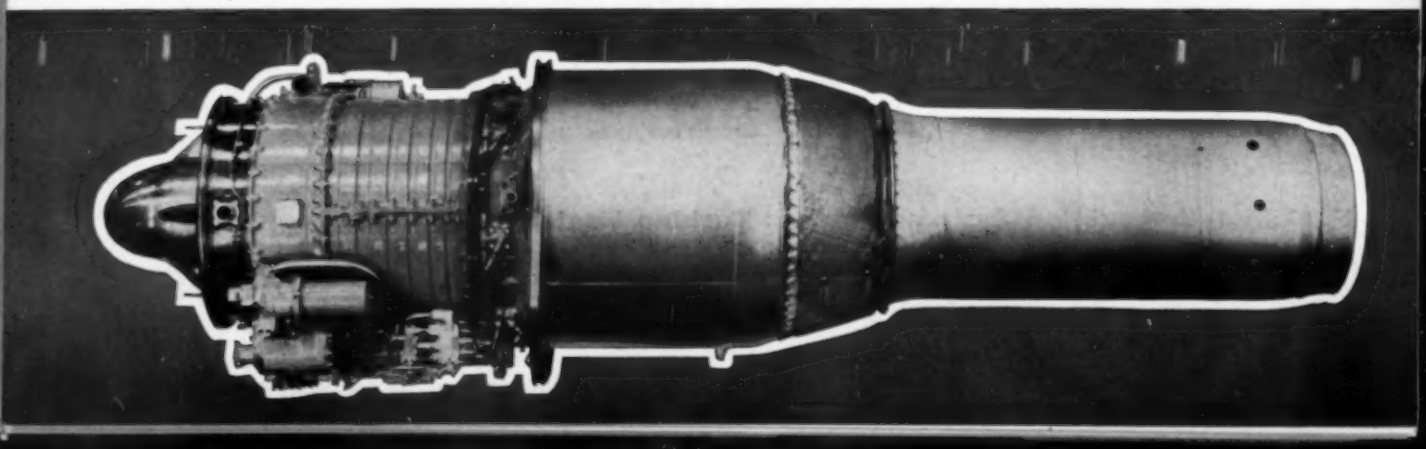
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